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# **WATERFOWL POPULATIONS IN THE UPPER CHESAPEAKE REGION**



**UNITED STATES DEPARTMENT OF THE INTERIOR  
FISH AND WILDLIFE SERVICE  
BUREAU OF SPORT FISHERIES AND WILDLIFE  
Special Scientific Report--Wildlife No. 65**

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# **WATERFOWL POPULATIONS IN THE UPPER CHESAPEAKE REGION**

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Branch of Wildlife Research  
Bureau of Sport Fisheries and Wildlife



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UNITED STATES DEPARTMENT OF THE INTERIOR

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Frank P. Briggs, Assistant Secretary for Fish and Wildlife

FISH AND WILDLIFE SERVICE

Clarence F. Pautzke, Commissioner

BUREAU OF SPORT FISHERIES AND WILDLIFE

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# WATERFOWL POPULATIONS IN THE UPPER CHESAPEAKE REGION

The Upper Chesapeake region is one of the more important areas in North America for migrating and wintering waterfowl.\* Conditions here affect the welfare of waterfowl populations in the entire Atlantic Flyway. During the more recent years of this study there was a noticeable decline in waterfowl populations in this region, probably as a result of destruction and disturbance of habitat along with a steady increase in hunting pressure. The purpose of this report is to present information on the distribution, ecology, and harvest of waterfowl in the Chesapeake Bay Region, so that this information can be used as a guide to management and preservation of waterfowl populations.

The Upper Chesapeake region, as referred to in this study, covers the tidewaters and the watersheds of the adjoining Coastal Plain of the upper portions of Chesapeake Bay, extends south to and includes Pocomoke Sound and Tangier Island along the eastern shore, and the entire Potomac River estuary along the western shore. The adjacent coastal area between the Maryland-Delaware line and Chincoteague, Virginia, although not part of Chesapeake Bay proper, also is included as part of the region because of its close geographical relationships with the Chesapeake area. The principal rivers, islands, and other prominent physiographical features of the Upper Chesapeake region are shown on the map in figure 1.

The intensive phase of this study was begun in April 1954 and continued for about 5 years. Data recorded on occasional field trips in the area during the years 1945 - 54 also are utilized in this report.

Results are organized in four major parts. The first, Size and Composition of the Population, concerns annual and seasonal variations in the numbers and kinds of waterfowl in the region as a whole. The second part, Waterfowl Habitats, defines 13 major habitats of the region, lists their principal plants, fishes, and invertebrates, and characterizes the annual and seasonal variations in their waterfowl populations. The third part, Biogeographical Sections, defines 15 biogeographical areas on the basis of waterfowl distribution and use and the combination of habitats composing each section. The fourth and major part, Species Accounts, comprises detailed accounts of the

individual species. Subjects included for the species are size of the Chesapeake population and its proportion in the Atlantic and continental populations, ecological distribution, biogeographical distribution, breeding, migration, food habits, local distribution of the hunting kill, and harvest areas of birds banded in the region.

Information concerning distribution and numbers of waterfowl during the winter came from the annual continental survey (January inventory) of the U. S. Bureau of Sport Fisheries and Wildlife. Data from surveys made during the 6-year period, 1953-58, are used in this report. During the last 4 years (1955-58), data were recorded separately for as many as 35 geographical survey units and therefore were especially useful in helping define the major biogeographical sections.

Information concerning distribution and numbers of waterfowl during the fall, winter, and early spring came from special aerial surveys during 1958-59. The tidewater areas were covered completely five different times. These special surveys were made by Charles D. Evans, Atlantic Flyway Biologist, with the assistance of Charles F. Kaczynski. Data were recorded separately for ecological units proposed by the author.

The reliability of aerial surveys is unknown, but it is believed that they provide at least fairly dependable indexes for most species. Certain species can be seen and counted more easily than others, so data concerning the relative numbers of the different kinds of waterfowl are not completely accurate. Aerial counts of certain species that are difficult to distinguish from the air often were recorded together. Thus the terms "scaup," "scoters," and "mergansers" as used throughout the text and tables refer to more than one species of each. Numbers of Common Goldeneyes and Buffleheads usually were combined also. Various sea ducks, including Oldsquaws, scoters, and mergansers were not censused adequately, because many of them often remain considerable distances offshore. Aerial surveys were not made in the Coastal Plain interior, because of the difficulty of seeing waterfowl along wooded streams and small impoundments. Except for Wood Ducks and Ring-necked Ducks, this omission is not believed to have altered the data significantly. Numerous ground checks of waterfowl in the interior indicated that less than 1% of the Upper Chesapeake population

\*The term "waterfowl" as used in this paper refers to the ducks, geese, and swans (Anatidae) and the American Coot.

stayed in areas away from the tidewater. Further discussion of aerial-survey methods and their limitations is given by Stewart, Geis, and Evans (1958).

Additional information concerning distribution and numbers of waterfowl at different seasons came from numerous local counts made from land or by boat. All important tidewater areas of the Upper Chesapeake region were covered in these ground surveys. Data were particularly useful for some of the more inconspicuous species that were difficult to census from the air. Most of the counts on open-water areas of the coastal and estuarine bays were made with the aid of a 20-power telescope from systematically selected observation points. All waterfowl within a radius of a quarter of a mile could be counted by this method. Waterfowl in marsh areas were counted from a motorboat along measured courses of tidal creeks or guts; with the aid of 7-power binoculars, all waterfowl observed within an eighth of a mile were counted. River marshes and many bay marshes could be completely covered from the watercourses, but in a few of the larger bay marshes it was necessary to make separate counts in various marsh ponds or "broken marshes" farther away from the watercourses. Counts from different years and different trips were combined by seasons to give a composite picture.

Information concerning plant associations was obtained from extensive ground surveys. Each of the major waterfowl areas was covered systematically. Lists of plants were made for numerous stations in each area, as well as detailed notes on abundance, associated plants, salinities, tides, and other environmental factors. Type maps were made for the entire area. Information on occurrence of invertebrate animals was obtained during the ground surveys and from the food contents of waterfowl.

Food-habits information was obtained from field observations and from examination of gullet and gizzard contents in the laboratory. Most of the specimens for food analysis were collected by the author, but considerable numbers also were collected by various personnel of the U. S. Bureau of Sport Fisheries and Wildlife and the Maryland Game and Inland Fish Commission during and before the present study. Analyses were made of 1,240 specimens. Of these, 952 were examined by the author, and 288 were examined by other biologists, chiefly F. M. Uhler and Clarence C. Cottam. The volume of the entire contents of the gullet and gizzard of each specimen was measured. The volumetric proportion (percent) of each food item was estimated visually.

The food-habits data were organized according to the habitat types from which the birds were collected. Food-habits data were expressed as percentage of birds in which the various food items occurred. Any occurrence

making up less than 5% of the particular stomach contents was omitted from the tabulation. In order to express the reliability of the percentage-occurrence figures, 95-percent confidence limits were read from the tables of Mainland, Herrera, and Sutcliffe (1956).

Information concerning the local distribution of the kill for a given species was based on the percentage distribution of band recoveries from birds reported as shot in the Upper Chesapeake region. Only recoveries of birds that had been banded outside Maryland and Virginia were used in these computations, and the data were adjusted so that each year's recoveries had the same weight. This was done by considering the total weight of all recoveries to be 100% and by calculating the weighted value of recoveries for each year as 100% divided by the number of years represented by recoveries. The weighted value of a single recovery for any particular year could then be obtained by dividing the weighted value of recoveries for each year by the number of recoveries for that particular year.

Information concerning distribution of the kill of Chesapeake birds throughout North America was obtained from birds banded in the Upper Chesapeake region. Conclusions were based on the percentage distribution of indirect recoveries from birds reported as shot.

Data on seasonal occurrence, migration peaks, and arrival and departure dates were taken chiefly from "Birds of Maryland and the District of Columbia" (Stewart and Robbins, 1958).

Identities and Latin names of all plants except algae are according to the eighth edition of Gray's manual (Fernald, 1950). Common and scientific names are listed in the appendix. Mollusk names were based chiefly on "A Field Guide to the Shells" (Morris, 1951). Most of the names of other invertebrates were taken from "Field Book of Seashore Life" (Miner, 1950), and "Ward and Whipple's Freshwater Biology" (Edmondson, 1959). Scientific names of fish and invertebrates were brought up to date by authorities at the U. S. National Museum, U. S. Agricultural Research Service, and the U. S. Fish and Wildlife Service.

The field and laboratory investigations were conducted with the halftime assistance of Don P. Fankhauser over a 2-1/2 year period and with the help of Charles F. Kaczynski for three-fourths of his time during 1 year. Both men worked with diligent perseverance toward the completion of a variety of tasks, including some that were physically strenuous and others that were very tedious.

The generous cooperation of many biologists, game technicians, and law-enforcement personnel is deeply appreciated. Charles D. Evans, Atlantic Flyway Biologist, was primarily responsible for the periodic aerial surveys of waterfowl populations during the 1958-59 season. Vernon D. Stotts and Richard N. Smith of

the Maryland Game and Inland Fish Commission collected large numbers of waterfowl gullets and gizzards from hunters in the important Chester River-Eastern Bay area. Illegally killed waterfowl from the Eastern Shore that had been confiscated by U. S. game management agents were made available for food-habits studies through the courtesy of Joseph D. Withers. William R. Nicholson, who was with the Maryland Game and Inland Fish Commission, furnished valuable aid in censusing waterfowl and collecting specimens in the marshes of Dorchester County and in the Chester River area. Paul F. Springer, of the U. S. Bureau of Sport Fisheries and Wildlife, helped in the survey of habitat conditions of several important waterfowl areas, and Clark G. Webster, of the same agency, collected a number of waterfowl in the Patuxent River bottomlands and also completed the analysis of their food contents.

My gratitude is extended to several biologists of the Bureau of Sport Fisheries and Wildlife for their assistance in the analysis of waterfowl foods. Special thanks are due F. M. Uhler, who aided in many of the more difficult identifications. Acknowledgements are also made to Neil Hotchkiss and A. C. Martin for their identification of some of the plant foods more difficult to identify, and to Robert T. Mitchell, who helped identify fragments of insects. Joseph P. E. Morrison of the U. S.

National Museum identified reference specimens of the various species of mollusks that had been consumed by waterfowl.

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## SIZE AND COMPOSITION OF THE POPULATION

### Annual changes

The approximate numbers of waterfowl wintering in the Upper Chesapeake region are shown in table 1. The Upper Chesapeake population averaged about 4% of the entire continental population and about 23% of the Atlantic population. Waterfowl gradually increased in the Upper Chesapeake region from 1953 to 1955, then decreased drastically from 1956 to 1958. This reduction probably was the result of increased hunting pressure along the migration routes and on the wintering areas, plus drouth in an increasingly greater part of the breeding grounds of the "prairie-provinces" of Canada.

Numbers of waterfowl in each of the groups varied considerably from year to year, but numbers of diving ducks and dabbling ducks varied most and influenced the overall totals most strongly. The numbers of geese varied least, indicating that the goose populations were more stable than the other waterfowl populations. Diving ducks reached maximum numbers in 1954, but all other groups, and the waterfowl population as a whole, reached greatest numbers in 1955. Waterfowl of all groups were at their lowest point in 1958, except for the sea ducks and mergansers, which were scarcer in 1956 and 1957. Since Upper Chesapeake waterfowl breed in many different areas, it is not surprising that changes in the numbers of different kinds of waterfowl are not always parallel.

Despite the general trends in numbers from year to year, there was enough variation that the different species and groups of species made up somewhat different proportions of the total population each winter. The Mallard, scaup, and Ruddy Duck varied more than the other species. Species composition of the wintering population in the different years is shown in table 2.

In the average for all years, diving ducks were most numerous, making up 42% of the population. Others, in order, were dabbling ducks (29%), geese (18%), swans (4%), coots (3%), sea ducks (Oldsquaws and scoters) and mergansers (2%), and unidentified ducks (2%). Considered by species, the Canvasback, Canada Goose, Black Duck, and scaup made up more than half the average winter population. Other important species included the Whistling Swan, Mallard, Pintail, American Widgeon, Redhead, and Ruddy Duck.

### Seasonal Changes

Seasonal changes in numbers of waterfowl are shown in table 3. The combined numbers of all species increase rather abruptly during late October and November and reach a peak in early December as large populations of both

transient and wintering waterfowl concentrate in the Upper Chesapeake region. Numbers decline gradually during the winter as transient populations continue to move southward. Numbers continue to decline in early spring (March) as departures of wintering birds outweigh arrivals of spring transients from the south. Numbers decline more conspicuously in April when most of the remaining transient and wintering birds leave for the breeding grounds to the far north and northwest. Only the local breeding birds remain during late spring and summer. Numbers increase again when fall migration begins in September.

Pronounced seasonal changes in populations of each major group of waterfowl also occur throughout the year (table 3). The populations of dabbling ducks and geese steadily build up during the fall, reaching a peak in late November and early December followed by a moderate decline in winter and a gradual movement out of the region in early spring (March and early April). Comparatively small breeding populations of dabbling ducks (chiefly Black Ducks) remain in the region during late spring and summer. Diving ducks arrive in large numbers in late fall (November and early December), reach their peak in winter, maintain their numbers fairly well in early spring (March) and then depart rather abruptly for the breeding grounds during April. Minor groups such as swans and coots reach their population peak in late fall, whereas sea ducks and mergansers ordinarily are most numerous in winter. The greatest concentrations of all major waterfowl groups occur during the late fall, winter, and early spring (November-March). Seasonal changes in populations of each species of waterfowl are described in detail in the species accounts.

Because of the population changes in various groups of waterfowl, the composition of the total waterfowl population varies considerably from one season to another. Major changes in composition that took place during the 1958-59 season (table 4) may be summarized as follows:

October 2-10.--Dabbling ducks were most numerous (87%), with American Widgeons alone making up 58% of the population. Black Ducks (18%) also were fairly numerous. Canada Geese were present in fair numbers (11%), but diving ducks were almost entirely lacking.

November 3-12.--Dabbling ducks (41%) were the predominant group, but diving ducks (27%) and geese (27%) also were important components of the total population. Canada Geese alone made up over one-fourth of the total population. American Widgeons, Ruddy Ducks, Black Ducks, and Canvasbacks constituted over one-half of the total.

December 1-12.--A mixture of diving ducks (36%), dabbling ducks (33%) and geese (23%) made up the greater part of the population. Canada Geese made up more than one-fifth of the total; Black Ducks and Canvasbacks together represented one-third; and the combined totals of Ruddy Ducks, scaup, Mallards, American Widgeons, Whistling Swans, and Pintails constituted more than one-third of the waterfowl population.

January 7-13.--As in December, the population was a mixture of diving ducks, dabbling ducks, and geese. Diving ducks (42%) were proportionally more important however, and the dabbling ducks (30%) less important than in December. Canada Geese,

Black Ducks, Canvasbacks, and scaup were predominant. Fairly large numbers of Mallards and Redheads also were present. March 3-16.--Diving ducks (54%) were the dominant waterfowl group. Canvasbacks, scaup, and Redheads were predominant. Canada Geese (21%) still were relatively abundant but dabbling ducks (18%) including Black Ducks (7%) were proportionally scarcer than previously.

During late spring and summer, following the termination of the spring flight, only the local breeding populations and occasional non-breeding stragglers remain in the region. Nearly all are dabbling ducks, chiefly Black Ducks, with small numbers of Blue-winged Teal and Wood Ducks, and a few Gadwalls.

## WATERFOWL HABITATS

The Upper Chesapeake region contains many different plant and animal communities. Thirteen major habitat types were defined as an aid in understanding the waterfowl populations. These major habitats were established primarily on the basis of plant associations and waterfowl use. The habitats differed also in salinities, water levels, and kinds and numbers of animals other than waterfowl.

Six of the habitats are in open tidewater areas. Together they occupy about 1,735,000 acres, including 435,000 acres of shoal waters less than 6 feet deep at mean low tide. They are fresh, slightly brackish, brackish, and salt estuarine bays (fig. 2), the coastal bays, and the littoral zone of the ocean. Five of the habitats are types of tidal marshes. They occupy about 278,000 acres and include coastal embayed marshes, salt, brackish, and fresh estuarine bay marshes, and estuarine river marshes (fig. 3). This classification is similar to the classification of tidal marshes proposed independently by Nicholson and Van Deusen (1954). The other two major habitats are within the coastal plain interior, and are designated as wooded bottomlands and interior impoundments. Most of these major habitats correspond fairly well with more generalized wetland types of wider geographical distribution described by Martin, Hotchkiss, Uhler, and Bourn (1953).

Changes in salinity in the bay affect all tidewater communities. Periodic salinity readings often fluctuate widely (Whaley and Hopkins, 1952). These changes apparently are produced primarily by variations in rainfall and stream run-off, but also are influenced by changes in the tide produced by prolonged or severe winds and storms.

The mean ranges of the tides (differences between mean high water and mean low water) in the Upper Chesapeake region are smaller than in most other regions along the Atlantic coast. Mean ranges of tides within the region varied as follows (Coast and Geodetic Survey, 1957): Ocean (3 stations), 3.4 to 3.7 ft.; coastal bays (3 stations), 0.4 to 0.6 ft.; Chesapeake Bay and adjoining estuaries (145 stations), 0.8 to 3.0 ft. In the Chesapeake Bay itself and in the lower portions of adjoining estuaries, most of the measurements varied from 1.0 to 2.0 feet; in the upper portions of most of the adjoining estuaries, measurements varied from 2.0 to 2.8 feet.

### FRESH ESTUARINE BAYS

Fresh estuarine bays (fig. 2) comprise approximately 157,000 acres in two widely separated areas. Approximately 61,000 acres of the total are in shoal water (less than 6 feet deep at mean low tide.) The most important

area is the extreme upper portion of Chesapeake Bay and its adjoining estuaries. Here the Susquehanna Flats are the principal focal point for migrating waterfowl. Other important estuaries include the Bush, Northeast, Elk, Bohemia, and Sassafras Rivers, and the upper portion of the Gunpowder River. The other area is the upper portion of the Potomac River estuary, from Maryland Point in Charles County, Maryland, to the District of Columbia.

### Vegetation

Extensive, luxuriant beds of submerged aquatic plants characterize the fresh estuarine bays:

#### Primary Species

Wildcelery	Muskgrass
Southern Naiad	

#### Secondary Species

Sago Pondweed	Claspingleaf Pondweed
Muckweed	Slender Naiad
Leafy Pondweed	Common Waterweed
Grassleaf Pondweed	Waterstargrass
Largeleaf Pondweed	Coontail
Longleaf Pondweed	Nitella
Variableleaf Pondweed	Spirogyra

Vegetation is more luxuriant on the Susquehanna Flats, where wildcelery and southern naiad ordinarily are the predominant species at depths ranging between 1-1/2 and 8 feet. Muskgrass often is dominant at depths less than 1-1/2 feet, particularly in areas with a hard sandy bottom. Most of the other species are most abundant between depths of 1-1/2 and 6 feet. Fewer kinds of plants occur in other nearby estuaries where waters are more turbid. Wildcelery and southern naiad, however, are common nearly everywhere. They can grow at a greater depth than many other aquatic plants (up to 10 feet if the water is fairly clear) and apparently can withstand a greater amount of turbidity.

At one time, vegetation in the upper Potomac estuary was as abundant and varied as on the Susquehanna Flats. The species were similar in the two areas except for one pondweed (*Potamogeton robbinsii*), which was common in the upper Potomac area but absent from the Chesapeake. Disturbances associated with high human populations have greatly reduced the quality of the waters of the Potomac area in recent years. Turbidity of the tidewaters has increased as a result of increasing soil erosion along the upper watersheds of the Potomac River, gravel-dredging operations along the Potomac estuary near the District of



Columbia, feeding activities of increasing numbers of the introduced European carp, and greater pollution of the river by domestic sewage from Washington, D.C., and its suburbs. According to observations made by F. M. Uhler, the increased domestic sewage in the river promoted a vigorous growth of blue-green algae, which decomposed and released poisonous substances that damaged many aquatic vascular plants. Furthermore, the prolonged unprecedented drouth from 1930 to 1932 brought slightly brackish estuarine waters up the river to the mouth of Occoquan Bay. During the same period, the introduced waterchestnut became more and more abundant in many areas and effectively crowded out many of the more desirable native aquatic plants (Gwathmey, 1945). As a result of these various changes, the greater part of the submerged vegetation of the upper Potomac estuary gradually disappeared during the period 1930-35.

At present, the portion of the Potomac River estuary downstream from the District of Columbia to Chicamuxen Creek (Charles County, Maryland) has no submerged vascular plants. Fairly extensive beds of submerged vegetation still occur in the fresh estuarine waters between Chicamuxen Creek and Maryland Point. Even these waters, however, are moderately turbid, so vegetation is restricted to narrow, shallow zones along the shores. The principal native plants are wildcelery, southern naiad, clasping leaf pondweed, and common waterweed. The introduced Eurasian watermilfoil recently has invaded this area and rapidly is becoming a serious pest.

## Fishes

Some of the more common species of freshwater fish include the yellow perch (*Perca flavescens*), chain pickerel (*Esox niger*), large-mouth black bass (*Micropterus salmoides*), crappie (*Pomoxis* sp.), pumpkinseed sunfish (*Lepomis gibbosus*), and bullhead (*Ictalurus nebulosus*). Certain brackish or saltwater fish often are abundant during spawning periods. These include the striped bass (*Roccus saxatilis*), white perch (*Roccus americanus*), white shad (*Alosa sapidissima*), hickory shad (*Pomolobus mediocris*), and alewife herring (*Pomolobus pseudoharengus*).

## Invertebrates

Pelecypod and gastropod mollusks and aquatic insects are the predominant invertebrates. Some of the characteristic species of invertebrates are:

### Pelecypod (bivalve) Mollusks

*Elliptio complanatus*  
*Anodonta* sp.  
*Sphaerium* sp.  
*Pisidium* sp.

### Gastropod (univalve) Mollusks

*Physa* sp.  
*Gyraulus* sp.  
*Valvata tricarinata*  
*Amnicola limosa*  
*Gillia altilis*  
*Oxytrema virginica*

### Cladocera

*Daphnia* sp.

### Amphipod Crustaceans

*Gammarus tigrinus*  
*Crangonyx* sp.

### Water Mites

Hydrachnellae

### Insects

Mayfly Nymphs (Ephemeroptera)  
 Dragonfly Nymphs (Anisoptera)  
 Water Boatmen (Corixidae)  
 Alderfly larvae (Sialidae)  
 Caddisfly larvae (Trichoptera)  
 Midge larvae (Chironomidae)

## Waterfowl

During spring and fall, often one-fourth or more of the Upper Chesapeake migrant waterfowl are on the fresh estuarine bays. During winter, less than 10% use this habitat.

Characteristic species of transient waterfowl are:

### Primary Species

Whistling Swan	Canvasback
Canada Goose (local)	Lesser Scaup
American Widgeon	American Coot
Redhead	

### Secondary Species

Mallard	Common Goldeneye
Black Duck	Bufflehead
Pintail	Ruddy Duck
Ring-necked Duck	Common Merganser

Other species that occur in small numbers include the Gadwall, Green-winged Teal, Blue-winged Teal, Greater Scaup, Oldsquaw, and Red-breasted Merganser.

Areas that still contain extensive beds of submerged aquatic plants are favored habitats for migrant populations of Canvasbacks and other diving ducks, American Widgeons, Whistling Swans, and American Coots. Areas along the Sassafras and Bohemia Rivers that adjoin extensive agricultural lands attract large numbers of Canada Geese and fair numbers of Mallards and Black Ducks. Wintering populations ordinarily are relatively small and vary considerably from year to year, depending on ice conditions.

Results of sample counts of waterfowl in fresh estuarine bays from September to April are shown in table 5. Approximately 135.5 square miles were covered in the surveys. The counts of different areas were quite variable, primarily because of the very large local concentrations of diving ducks. The highest populations were in December, and the lowest in September.

The gullet and gizzard food contents of 147 waterfowl collected in fresh estuarine bays were examined. From these, certain generalizations can be made concerning food habits. The principal foods were: wildcelery (leaves, stems and rootstalks); various pondweeds, chiefly sago pondweed, claspingleaf pondweed, grassleaf pondweed, and southern naiad (leaves, stems, rootstalks and seeds); and various species of small gastropod (univalve) mollusks, chiefly *Oxytrema virginica*, *Gyraulus* sp., and *Ammicola limosa*. Other foods occasionally taken in fairly large quantities include: corn (taken as illegal bait or in nearby grainfields); aquatic insect larvae, chiefly caddisflies (Trichoptera) and mayflies (Ephemeroptera); and small fish, chiefly minnows (Cyprinidae) and sunfish (*Lepomis* sp.).

#### SLIGHTLY BRACKISH ESTUARINE BAYS

Slightly brackish estuarine bays (fig. 2) in the Upper Chesapeake region amount to approximately 182,000 acres. This includes about 24,000 acres of shoal waters.

There are two major and several minor areas of this habitat. One major area is the central portion of the Potomac River estuary, from Cobb Island to Maryland Point (Charles County, Maryland), including the Wicomico and Port Tobacco Rivers and Nanjemoy Creek. The other major area is along the upper western shore of Chesapeake Bay, from Pinehurst in Anne Arundel County to Leges Point on Gunpowder Neck (Harford County), including the Patapsco River, Back River, Middle River, Seneca Creek, and the lower portion of the Gunpowder River. A minor area extends along the upper eastern shore of Chesapeake Bay in Kent County from Swan Point to Worton Point. Other smaller areas are in the upper portions of the Magothy and Severn River estuaries.

#### Vegetation

Luxuriant growth of submerged aquatic plants occurs in the shallower zones of all areas, except for areas that have been heavily polluted with domestic or industrial wastes. The predominant species are claspingleaf pondweed, wildcelery, and widgeongrass. Other species that are widely distributed and fairly common locally include sago pondweed, horned pondweed, southern naiad, common waterweed,

grassleaf pondweed, muskgrass, and certain types of red algae. Scattered patches of muckweed and coontail also are present in a few areas. Many of the more sheltered coves and tributary tidal streams in the Potomac River area are choked with dense, nearly pure, stands of the introduced Eurasian water-milfoil. This aggressive plant has become a serious pest and a real danger to the remaining beds of native submerged plants.

#### Invertebrates

Invertebrates were not studied in detail. General observations indicated that the bivalve *Macoma phenax* is one of the major species. Barnacles (*Balanus* sp.) also were noted occasionally. The invertebrate fauna in general probably is somewhat intermediate between that of brackish estuarine bays and that of fresh estuarine bays.

#### Waterfowl

In early fall and in winter, approximately 7% of the waterfowl population of the Upper Chesapeake occurs in slightly brackish estuarine bays. From 9% to 14% of the population is here in the late fall and early spring.

Most waterfowl areas in this habitat are subject to considerable human disturbance in the form of boating, excessive hunting pressure, artillery firing from adjacent military reservations, and domestic and industrial pollution from nearby cities and factories. These activities definitely limit waterfowl use.

Characteristic species of transient and wintering waterfowl are:

##### Primary Species

American Widgeon	Lesser Scaup
Redhead (local)	Ruddy Duck
Canvasback	American Coot

##### Secondary Species

Whistling Swan	Ring-necked Duck
Canada Goose	Common Goldeneye
Black Duck	Bufflehead
Gadwall (local)	Common Merganser

Other species occasionally observed in small numbers include the Mallard, Pintail, Green-winged Teal, Greater Scaup, Oldsquaw, Hooded Merganser, and Red-breasted Merganser.

The Ruddy Duck usually is the most abundant species in this habitat and also is commoner here than in any other habitat. Often there are large local concentrations of Redheads, especially in the lower Gunpowder River - Seneca Creek area during the spring flight. Canvasbacks normally are common and widespread throughout the late fall, winter, and

early spring. Large numbers of Lesser Scaup usually appear during the spring. American Widgeons and American Coots often are quite numerous during both spring and fall flights, and fairly large numbers of Gadwalls are present in certain parts of the Potomac River area.

Results of sample counts of waterfowl in slightly brackish estuarine bays from September to April are shown in table 6. Approximately 10.1 square miles were covered in the surveys. From 1,600 to 38,000 birds were counted per square mile. Although more birds were counted than in other habitats, Ruddy Ducks made up a much larger proportion.

The general food habits of waterfowl in this habitat probably are intermediate between the food habits of waterfowl in brackish estuarine bays and of those in fresh estuarine bays. Two specimens were collected for food habits analysis: A Mallard taken in January had been feeding on the leaves, stems, roots, and seeds of claspingleaf pondweed, and on the seeds of widgeongrass. An American Coot, collected in October, had been feeding chiefly on the leaves, stems, and root-stalks of claspingleaf pondweed, widgeongrass, and wildcelery, and also contained a few seeds of widgeongrass and wildcelery.

Where Eurasian watermilfoil had become established in the Potomac River section, waterfowl were comparatively scarce. Fair numbers of American Widgeons, Gadwalls, and American Coots were observed there, however. On October 22, 1957, 300 American Widgeons and 230 American Coots in a mixed flock were observed feeding exclusively on the leaves of Eurasian watermilfoil.

## BRACKISH ESTUARINE BAYS

The total area of brackish estuarine bays (fig. 2) in the Upper Chesapeake region amounts to approximately 362,000 acres. This includes about 70,000 acres that may be classified as shoal waters.

The principal, centrally located areas include the wide, open estuaries of the Chester River, Eastern Bay, and Choptank River along the eastern shore of Chesapeake Bay, and the Magothy, Severn, South, Rhode, and West Rivers on the western shore. There also are fairly large brackish estuarine bays on the Potomac River between Piney Point and the mouth of the Wicomico River, and on the Patuxent River between Point Patience and Deep Landing. Smaller areas are in the lower eastern shore and Blackwater-Nanticoke sections; these include Ellis Bay, and the upper estuarine bays of the Nanticoke River and Fishing Bay.

## Vegetation

Great beds of submerged aquatic plants are widely distributed throughout the shallower portions of most of the brackish estuarine bays. The predominant species are widgeongrass, claspingleaf pondweed, and sago pondweed. Large quantities of eelgrass also are present in certain areas, especially in Eastern Bay and the Choptank River, and, to a lesser extent, in the Patuxent River. Common waterweed, sea-lettuce, the alga *Enteromorpha*, and two or three species of red algae are common locally. Scattered patches of horned pondweed are present in some areas. The introduced Eurasian watermilfoil is abundant locally in many of the more sheltered coves and tributaries of the Potomac River area.

The brackish estuarine bays of the Blackwater-Nanticoke section differ in that they have almost no submerged plants. This apparently is the result of an excessive amount of organic stain and silt from nearby marshes and swamps.

## Fishes and Invertebrates

The animal life beneath the surface of the brackish estuarine bays is abundant and diversified. Numerous species of fish and a great variety of invertebrates normally are present, even in the turbid waters of the Blackwater-Nanticoke section. More characteristic invertebrates are:

### Colonial Hydroids Hydromedusae

### Jellyfishes *Dactylometra quinquecirrha*

### Comb-jellies *Mnemiopsis leidyi*

### Annelid Worms Clam Worms (*Nereis* sp.)

### Pelecypod (bivalve) Mollusks Oyster (*Crassostrea virginica*) Bent Mussel (*Brachidontes recurvus*) Platform Mussel (*Congeria leucopheata*) Morton's Cockle (*Laevicardium mortoni*) Gem Shell (*Gemma gemma*) Baltic Macoma (*Macoma balthica*) *Macoma phenax* Little Surf Clam (*Mulinia lateralis*) Soft-shelled Clam (*Mya arenaria*)

### Gastropod (univalve) Mollusks *Odostomia impressa* *Triphora perversa* *Bittium varium* Dog Whelks (*Nassarius* spp.) *Sayella chesapeakea* *Acteocina canaliculata*

## Barnacles

*Balanus* sp.

## Isopod Crustaceans

*Cyathura* sp.

*Chiridotea coeca*

*Erichsonella attenuata*

## Amphipod Crustaceans

Gammaridae

## Decapod Crustaceans

Mud Crab (Xanthidae)

Blue Crab (*Callinectes sapidus*)

## Ascidians

Sea Grapes (*Molgula manhattensis*)

## Waterfowl

The brackish estuarine bays are the most important waterfowl habitat in the Upper Chesapeake region. Between one-half and three-fifths of the late fall and winter population occurs in this habitat and large numbers of waterfowl also are present in early fall and early spring. Unusually large populations of Black Ducks breed in the Chester River - Eastern Bay area, and fair numbers are found along the Choptank River. Characteristic species of transient and wintering waterfowl are:

### Primary Species

Whistling Swan	Redhead (local)
Canada Goose (local)	Canvasback
Mallard (local)	Lesser Scaup
Black Duck (local)	Common Goldeneye
American Widgeon	Ruddy Duck

### Secondary Species

Pintail (local)	Bufflehead
Green-winged Teal	Oldsquaw
Blue-winged Teal	White-winged Scoter
Ring-necked Duck	Red-breasted Merganser
Greater Scaup	American Coot

Large numbers of Canada Geese, Mallards, Black Ducks, and Pintails concentrate in the brackish estuarine bays that are adjacent to the large agricultural fields along the eastern shore of Chesapeake Bay in the Chester River, Eastern Bay, and Choptank River areas. Elsewhere these species are scarce or local. In the agricultural areas, the birds feed both in the grain fields and in the shoalwaters. They usually roost on the bays, but occasionally roost on artificial impoundments that are scattered among the farm lands. Great flights frequently trade back and forth between the feeding and roosting grounds at dawn and dusk.

Whistling Swans, American Widgeons, various diving ducks, and American Coots usually

feed and roost on the bays and are not greatly influenced by the agricultural areas. American Widgeons do occasionally feed in nearby grain fields. Canvasbacks are fairly evenly distributed on the brackish estuarine bays, but Redheads concentrate in the areas of the eastern shore. Lesser Scaup and Ruddy Ducks are much more numerous along the western shore and in the Potomac and Patuxent areas.

Canvasbacks, Lesser Scaup, Common Goldeneyes, and Ruddy Ducks are the principal waterfowl on Fishing Bay and the Nanticoke River, where submerged plants are scarce. All of these can feed to a considerable extent on animal food. Canada Geese and Black Ducks occasionally use these waters as sanctuaries, when they have been driven out of the surrounding marshes by excessive hunting or extensive ice formation.

Results of sample counts in brackish estuarine bays are shown in table 7. Approximately 27.5 square miles were covered. The population densities of waterfowl within a quarter mile of the shore ranged from about 1,700 to 12,500 birds per square mile.

The gullet and gizzard food contents of 372 waterfowl collected in brackish estuarine bays were examined. The major waterfowl foods, in order of importance, were widgeongrass, corn (illegal bait or from nearby grainfields), the bivalve Baltic macoma (*Macoma balthica*), claspingleaf pondweed, and mud crabs (Xanthidae), eelgrass, and the little surf clam (*Mulinia lateralis*).

## SALT ESTUARINE BAYS

The total area of salt estuarine bays (fig. 2) in the Upper Chesapeake region amounts to approximately 923,000 acres and includes about 196,000 acres that may be classified as shoal waters. This habitat extends into the Upper Chesapeake region to southern Kent Island on the eastern shore and to the Shadyside peninsula on the western shore. It includes Pocomoke Sound, Tangier Sound, Big Annemessex River, Manokin River, Monie Bay, Honga River, Tar Bay, Herring Bay, and the mouths of the Nanticoke River, Fishing Bay, Little Choptank River, Choptank River, Eastern Bay, Patuxent River, and Potomac River.

## Vegetation

Submerged aquatic plants occur chiefly at depths of 8 feet or less at mean low tide. Eelgrass, widgeongrass, and sea-lettuce are most widely distributed. Sago pondweed is common locally, and is especially abundant in moderately saline areas such as Tar Bay and the Honga River, and the vicinity of Bloodsworth Island. Horned pondweed and the green alga *Enteromorpha* are present as

occasional patches. Two or three species of red algae are widespread and common.

## Fishes

The numerous species of fish include several commercial varieties such as the bluefish (*Pomatomus saltatrix*), striped bass (*Morone saxatilis*), white perch (*Morone americanus*), weakfish (*Cynoscion regalis*), spot (*Leiostomus xanthurus*), croaker (*Micropogon undulatus*), and flounder (*Paralichthys dentatus*).

## Invertebrates

Nearly all major groups of invertebrates are represented in this habitat. Some of the more characteristic species are:

### Sponges

Red Sponge (*Microciona prolifera*)

### Jellyfishes

*Dactylometra quinquecirrha*

### Comb-jellies

*Mnemiopsis leidyi*

### Annelid Worms

Clam Worm (*Nereis* sp.)

### Pelecypod (bivalve) Mollusks

Oyster (*Crassostrea virginica*)

Bent Mussel (*Brachidontes recurvus*)

Gem Shell (*Gemma gemma*)

Quahog (*Mercenaria mercenaria*)

Baltic Macoma (*Macoma balthica*)

Stout Razor Clam (*Tagelus plebeius*)

Little Surf Clam (*Mulinia lateralis*)

Softshelled Clam (*Mya arenaria*)

### Gastropod (univalve) Mollusks

*Odostomia impressa*

*Bittium varium*

*Mitrella lunata*

Dog Whelks (*Nassarius* spp.)

*Sayella chesapeakea*

*Acteocina canaliculata*

### Barnacles

*Balanus* sp.

### Amphipod Crustaceans

Gammaridae

### Decapod Crustaceans

Sand Shrimp (*Crangon septemspinosa*)

Common Prawn (*Palaemonetes vulgaris*)

Mud Crab (Xanthidae)

Blue Crab (*Callinectes sapidus*)

### Horseshoe Crabs

*Limulus polyphemus*

### Ascidians

Sea Grapes (*Molgula manhattensis*)

## Waterfowl

Numbers of waterfowl wintering in salt estuarine bays may vary greatly from year to year. Populations usually are high during severe, cold winters, when many waterfowl leave areas of lower salinity because of extensive ice formation. Populations are comparatively low during mild winters.

The characteristic species of transient and wintering waterfowl are:

### Primary Species

Greater Scaup

Oldsquaw

Lesser Scaup

White-winged Scoter

Common Goldeneye

Red-breasted Merganser

Bufflehead

### Secondary Species

Whistling Swan (local)

Redhead (local)

Canada Goose

Canvasback

Brant (local)

Surf Scoter

Black Duck

Ruddy Duck

Pintail

The various diving ducks, sea ducks, and mergansers are quite generally distributed, with the exception of Redheads, which usually congregate in large numbers in the Honga River and Tar Bay areas in the extensive beds of sago pondweed. Whistling Swans and Brant are characteristic inhabitants in certain places along the lower Eastern Shore. Canada Geese and certain species of dabbling ducks, chiefly Black Ducks and Pintails, occur regularly on shoal-water areas that are located near extensive marshes of the salt estuarine bays or near large grain fields.

Results of sample counts in 3.1 square miles of salt estuarine bays are shown in table 8.

The gullet and gizzard food contents of 58 waterfowl collected in salt estuarine bays were examined. The leaves, stems, and root-stalks of eelgrass and widgeongrass were the chief natural vegetable foods. Large amounts of corn were taken, either from illegally baited areas or from crop fields. Invertebrate animal foods were more important than in other estuarine habitats. The principal pelecypod (bivalve) mollusks included the Baltic macoma (*Macoma balthica*), little surf clam (*Mulinia lateralis*), and the gem shell (*Gemma gemma*). The predominant gastropod (univalve) mollusks were *Acteocina canaliculata*, *Nassarius* spp., *Bittium varium*, and *Mitrella lunata*.

## COASTAL BAYS

The coastal bays are shallow lagoons separated from the ocean by narrow, sandy strips of barrier beach. They include Chincoteague, Newport, Sinepuxent, Isle of Wight, and

Assawoman Bays, and the St. Martins River, about 85,000 acres in all. With the exception of dredged channels, nearly the entire area is less than 6 feet deep at mean low tide.

The bay waters are in contact with the ocean only through the narrow Ocean City inlet and through various creeks and narrows at the lower end of Chincoteague Bay. These connections cause a slight tidal fluctuation of the bays, usually amounting to less than 1 foot. Extensive shoals, often less than 1 foot deep, border the barrier beaches; water is noticeably deeper along the mainland side of the bays. Because of evaporation, salinity in the coastal bays sometimes is greater than in the ocean.

### Vegetation

Plants of this habitat are kinds that are able to withstand high salinities. Sea-lettuce and another green alga, *Enteromorpha*, are abundant in the shallower portions, and various species of red and brown algae are common. Submerged vascular plants are local and scarce at present, although extensive beds of eelgrass grew over most of the coastal bay areas before 1931 (Cottam and Munro, 1954).

### Fishes and Invertebrates

Various fish, mollusks, and crustaceans are common throughout the coastal bay areas. Small razor clams, *Tagelus divisus*, the bivalve Baltic macoma (*Macoma balthica*), amphipod crustaceans (Gammaridae), and isopod crustaceans (*Chiridotea coeca*) were found in the gulleets or gizzards of waterfowl collected for food-habits study.

### Waterfowl

Transient and wintering waterfowl are fairly common, and sometimes locally abundant on the coastal bays. Brant are especially numerous. They usually concentrate in shoal-water areas along the barrier beach side. Fair-sized flocks of Canada Geese and Black Ducks also are often present on the shoals, ranging back and forth from there to adjacent coastal embayed marshes and nearby agricultural fields. Diving ducks, sea ducks, and mergansers usually are most numerous in the deeper portions of the bays, near the mainland shores. The predominant waterfowl in deep water are Greater Scaup, Common Goldeneyes, Buffleheads, Oldsquaws, White-winged Scoters, Surf Scoters, and Red-breasted Mergansers. Others that occasionally are fairly numerous include American Widgeons, Canvasbacks, Lesser Scaup, and Common Scoters.

Results of sample counts on coastal bays are shown in table 9.

The gullet and gizzard food contents of 22 waterfowl collected on the coastal bays were examined. Sea-lettuce, eelgrass, corn, and several invertebrate species were the principal foods in this small series.

### OCEANIC LITTORAL ZONE

The portion of the littoral zone occupied by waterfowl extends outward from the beach for about 1 mile. In the Upper Chesapeake region this area covers approximately 26,000 acres, including about 1,000 acres of shoal water. Macroscopic plant life is comparatively scarce, but many kinds of fish and numerous species of mollusks, crustaceans, and other invertebrates are plentiful.

Many thousands of sea ducks occasionally flock in the littoral zone during the fall, winter, and spring. Predominant sea ducks (in the order of abundance) are Surf Scoters, White-winged Scoters, and Common Scoters. Oldsquaws and Red-breasted Mergansers sometimes are fairly numerous.

Unusually large concentrations of sea ducks were present in the oceanic littoral area between Ocean City and the Maryland-Delaware line on April 6, 1946, and on March 1, 1955. Counts were made from 10 observation points on March 1, 1955, with these totals: Surf Scoters, 19,014; White-winged Scoters, 4,700; Common Scoters, 1,893; Red-breasted Mergansers, 31; scaup, 3; and Ruddy Duck, 1. Counts from four observation points on April 6, 1946, were: Surf Scoters, 8,400; White-winged Scoters, 8,004; Common Scoters, 6,300; and Red-breasted Mergansers, 21.

### COASTAL EMBAYED SALT MARSHES

The shallow bays just back of the barrier beaches along the coast are fringed with coastal embayed salt marshes (fig. 3). These marshes, which include approximately 21,000 acres in the Upper Chesapeake region, extend southward from Cape Henlopen, Delaware, about 55 miles to the lower end of Chincoteague Bay, where they adjoin the coastal sea-island salt marshes of Virginia.

### Vegetation

Saltmarsh cordgrass is the predominant plant. It grows in nearly pure stands throughout most of the coastal embayed salt marshes, but the plants are much shorter than those of the same species in the extensive stands of the coastal sea-island salt marshes to the south. Emergent marsh plants that grow in scattered patches include saltmeadow cordgrass, saltgrass, needlerush, blackrush, and

glasswort. Hightide-bush grows in narrow bands on the more elevated natural levees of the tidal creeks or guts and on the spoil banks of drainage ditches; it grows in fairly broad zones along the upland margins of the marshes, often associated with groundselbush, waxmyrtle, bayberry, and other shrubs. Sea-lettuce is common at the mouths of tidal creeks. Some widgeongrass usually is present in marsh ponds with poor drainage, and is fairly abundant in certain artificial ponds impounded by gut plugs or dams. Small pockets of brackish or fresh estuarine marsh occur along the mainland side of the coastal embayed marshes near the upper limits of tide water, where small streams drain into the marsh. The more important plant species in these restricted areas include Olney three-square, common three-square, big cordgrass, and rosemallow.

### Fishes and Invertebrates

Numerous small fish of various species inhabit the coastal embayed salt marshes. Good-sized schools of broad killifish (*Cyprinodon variegatus*), striped killifish (*Fundulus majalis*), and common killifish (*Fundulus heteroclitus*) abound in the creeks or ponds. Among the invertebrates, saltmarsh snails (*Melampus bidentatus*) and periwinkle snails (*Littorina irrorata*) are common and widespread. Clusters of ribbed mussels (*Volvella demissa*) are frequent along the margins of tidal creeks and guts. Swarms of fiddler crabs (*Uca pugnax*) and fair numbers of marsh crabs (*Sesarma reticulatum*) are present on the tidal mud flats, along with numerous amphipod, copepod, and shrimp-type decapod crustaceans.

### Waterfowl

The characteristic species of transient and wintering waterfowl are:

#### Primary Species

Canada Goose	Black Duck
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#### Secondary Species

Snow Goose	Shoveler
Mallard	American Widgeon
Pintail	Hooded Merganser
Green-winged Teal	American Coot
Blue-winged Teal (transient)	

Black Ducks are the only common and widely distributed waterfowl. Canada Geese are numerous only in a few local areas.

Black Ducks, Mallards, and Green-winged Teal generally are most numerous along the tidal creeks and guts. Canada Geese and Snow Geese are most numerous on the more extensive saltmarsh cordgrass areas or on tidal mud flats. Pintails, Shovelers, Blue-winged

Teal, and American Widgeons prefer the open marsh ponds with poor drainage, or ponds with stable water level that have been created artificially.

Scattered pairs of Black Ducks breed on the coastal embayed salt marshes, and occasionally a pair or two of Mallards or Blue-winged Teal. Isolated islands of marsh in the coastal bays apparently are more attractive for nesting than the marshes along the shore. All nests found were in the drier, more elevated portions of the marsh.

Sample boat counts of waterfowl made on March 2, 1955, and on December 27, 1955, covered approximately 2,875 acres. A total of 1,919 waterfowl was recorded, a density of about 430 birds per square mile. Canada Geese made up more than one-third of the total, and Black Ducks made up another third.

The gullet and gizzard food contents of nine waterfowl collected in the coastal embayed salt marshes were examined. Commonest plant foods were seeds of Olney three-square, common three-square, and widgeongrass. The saltmarsh snail (*Melampus bidentatus*) was the predominant food item taken by the six Black Ducks examined.

Canada Geese and Snow Geese were observed to feed to a considerable extent on the leaves and rootstalks of saltmarsh cordgrass as well as on corn and grain sprouts in fields nearby.

### SALT ESTUARINE BAY MARSHES

The salt estuarine bay marshes (fig. 3) occupy approximately 113,000 acres. They include the large off-shore islands (Bloodsworth, South Marsh, Smith, and Tangier Islands) as well as the outer fringe of marsh along the bay shores of Dorchester and Somerset Counties, Maryland, and adjacent portions of Virginia. Salinity is high and tidal fluctuations are narrow.

### Vegetation

The more characteristic plants of salt estuarine bay marshes are:

#### Primary Species

Widgeongrass	Saltmarsh Bulrush
Saltgrass	(local)
Saltmarsh Cordgrass	Needlerush
Saltmeadow Cordgrass	Hightide-bush

#### Secondary Species

Fimbristylis ( <i>F. castanea</i> )	Sea-lavender
Blackrush	Seaside Goldenrod
Atriplex	Aster
Glasswort ( <i>Salicornia europaea</i> )	( <i>A. tenuifolius</i> )
Saltmarsh Mallow	Groundselbush
	Saltmarsh Fleabane

Rather drab and monotonous expanses of marsh are dominated by nearly pure stands of needlerush over large areas. Saltmeadow cordgrass dominates good-sized meadows in better-drained areas above normal high-tide level. Saltmarsh cordgrass occurs along tidal streams in narrow well-drained zones that are frequently inundated during normal high tides. Saltmarsh bulrush and saltgrass grow in patches in a few poorly drained depressed areas that contain considerable standing water at low tide. They grow in more extensive stands locally, particularly in the Dames Quarter and Fairmount areas. Saltgrass also grows with needlerush, saltmeadow cordgrass, and saltmarsh cordgrass. Narrow strips of hightide-bush grow along the upper portions of many of the tidal streams where natural levees have been built above normal high tide level. Widgeongrass is an abundant submerged plant throughout most of the ponds and creeks, where the circulating tidewater is normally quite clear. Switchgrass meadows are widespread along the upland margins of the marshes. In other places, the marsh border is composed chiefly of groundselbush and wax-myrtle, representing a later stage of plant succession.

During recent years, the Maryland Game and Inland Fish Commission has made numerous impoundments in the salt estuarine bay marshes near Dames Quarter, through the construction of dikes, dams, and gut plugs. This has stabilized the water level and reduced the salinity so that new species of aquatic and marsh plants have become established. Species important to waterfowl include muskgrass, sago pondweed, narrowleaf cattail, and Olney three-square.

## Fishes and Turtles

Several species of small fish are numerous. These include the common killifish (*Fundulus heteroclitus*), the striped killifish (*Fundulus majalis*), and the broad killifish (*Cyprinodon variegatus*). The diamondback terrapin (*Malaclemys terrapin*) also is common.

## Invertebrates

Certain mollusks are quite common, particularly the ribbed mussel (*Velosella demissa*), the periwinkle snail (*Littorina irrorata*), the saltmarsh snail (*Melampus bidentatus*), and a tiny gastropod (*Littoridinops* sp.). Of crustaceans, the most numerous include one of the fiddler crabs (*Uca minax*), the mud crab (*Panopeus herbstii*), the blue crab (*Callinectes sapidus*), and various amphipods and isopods. Characteristic aquatic insects are: the larvae and nymphs of dragonflies (Libelluloidea), water boatmen (Corixidae), predaceous diving beetles (Dytiscidae), water scavenger beetles (Hydrophilidae), and

the larvae and pupae of mosquitoes (Culicidae).

## Waterfowl

The characteristic species of waterfowl during the spring and fall migration periods are:

### Primary Species

#### Black Duck

### Secondary Species

Canada Goose	Green-winged Teal
Mallard	Blue-winged Teal
Gadwall	Shoveler
Pintail	American Widgeon

Black Ducks are the only common and widely distributed waterfowl. They are present regularly as breeding populations, spring and fall transients, and winter residents. They are not as numerous in this habitat, however, as they are in the brackish estuarine bay marshes during the migration periods.

Other species of waterfowl are scarce and somewhat irregular. Various dabbling ducks and Canada Geese occur locally in managed areas, where ponds have been made by gut plugs and dams along tidal streams. During the late spring and summer, a few scattered pairs of Blue-winged Teal breed in some of the larger marsh-meadows that are dominated by saltmeadow cordgrass. A small local population of breeding Gadwalls is present near Dames Quarter in an area that contains extensive stands of saltmarsh bulrush as well as the more typical plant associations.

Sample boat counts were made during the period of 1954-56, between the dates of May 29 and June 11. Approximately 16.6 square miles were covered in these censuses. Altogether 75 waterfowl were recorded, about 5 waterfowl per square mile. They included 71 breeding Black Ducks and 4 nonbreeding Red-breasted Mergansers.

The gullet and gizzard food contents of 16 waterfowl collected in salt estuarine bay marshes during the fall migration were examined. Small fish (chiefly Poeciliidae) were the predominant foods taken by 13 Black Ducks. Two Mallards had been feeding chiefly on bait corn, and on the seeds of saltgrass. A Green-winged Teal had been feeding heavily on seeds of needlerush.

Three downy-young Black Ducks collected in June contained only widgeongrass seeds and saltmarsh snails (*Melampus bidentatus*).

## BRACKISH ESTUARINE BAY MARSHES

About 47,000 acres of brackish estuarine bay marsh (fig. 3) occur in the Upper Chesapeake region.



A large expanse, approximately 32,000 acres, is located in southern Dorchester County, Maryland, and drains into Fishing Bay and the Nanticoke River. This area includes the lower watersheds of the Blackwater River, Transquaking River and Ireland Creek, and the entire watersheds of Irish, Jacks and Cow Creeks (Ireland Creek and Cow Creek are the common names for Island Creek and Langrells Creek of the U. S. Geological Survey maps). Smaller areas of this marsh type are located on the watershed of Broad Creek, draining into Ellis Bay in Wicomico County, Maryland (about 3,600 acres); and on the watershed of Marumsco Creek, draining into Pocomoke Sound in Somerset County, Maryland (about 2,700 acres). Small patches or fringes of this marsh type also occur along some of the brackish estuarine bays, and particularly along Eastern Bay and the Chester River in the Kent Narrows and Eastern Neck Island areas. This habitat is a complex mosaic of ponds, creeks, and marshes. Different plant species are dominant in different areas. The more characteristic species are:

#### Primary Species

Widgeongrass	Saltmeadow Cordgrass
Saltgrass	Olney Three-square
Big Cordgrass	Needlerush
Saltmarsh Cordgrass	Hightide-bush

#### Secondary Species

Muskgrass	Lythrum
Dwarf Spikerush	Sea-lavender
Fimbristylis	Rosegentian
( <i>F. castanea</i> )	Seaside Goldenrod
Saltmarsh Bulrush	Aster
Atriplex	( <i>A. tenuifolius</i> )
Glasswort	Groundselbush
( <i>Salicornia europaea</i> )	Saltmarsh Fleabane
Saltmarsh Mallow	

Certain fairly definite plant associations are widespread and characteristic of the habitat. Big cordgrass, associated with atriplex, sea-lavender, and other subdominant plants, usually occurs as a narrow zone along the margins of tidal creeks and ponds of the drainage systems. Marginal thickets of hightide-bush and occasional groundselbush often replace the big cordgrass association in some of the higher marshes that have less tidal fluctuation. Saltmeadow cordgrass usually is the dominant plant in marshmeadows of the comparatively dry and well-drained zone adjacent to pond and creek borders. Locally saltgrass and saltmarsh cordgrass may grow with the saltmeadow cordgrass or replace it. Secondary or subdominant species characteristic of marshmeadows include: fimbristylis, saltmarsh mallow, lythrum, sea-lavender, rosegentian,

seaside goldenrod, aster, and saltmarsh fleabane. A short growth form of saltmarsh cordgrass grows in nearly pure stands on the well-drained tidal flats that terminate many of the smaller creeks or guts. These flats are covered with considerable water during normal hightides. Glasswort also is common locally on these flats. Olney three-square is the dominant plant in extensive, poorly drained shallow depressions of the marsh that normally are covered with considerable surface water. Saltgrass is a common associate of the Olney three-square, and saltmarsh bulrush occurs in occasional patches. Nearly pure stands of needlerush or mixed stands of needlerush and saltgrass dominate the poorly drained areas that normally have little or no surface water.

Submerged aquatic plants are quite scarce or absent from the tidal creeks, guts, and ponds. Patches of dwarf spikerush do grow on shallow mud bars that are exposed at low tide. The scarcity of plants probably is the result of excessive turbidity and scouring by silt-laden water. Turbidity is caused in part by tidal scouring action and also by the considerable amount of organic stain and silt that is carried in from the upper watersheds of many of the larger streams. Salinity of the water apparently is not great enough to precipitate the solid particles. Widgeongrass is dominant in the shallow "still-water" ponds that are situated within the poorly drained marsh depressions. Muskgrasses also are common locally in the still-water ponds and sago pondweed occurs occasionally. Many of the ponds are believed to have originated from muskrat "eatouts". They ordinarily do not connect directly with tidal streams of the drainage systems, and therefore are not appreciably affected by normal daily fluctuations of the tide. Similar ponds often are created artificially by constructing gut plugs or dams on tidal streams.

#### Vertebrates other than waterfowl

Brackish estuarine bay marshes have a diverse vertebrate fauna. There are 5 species of mammals, 28 species of birds, 2 species of reptiles, and 5 species of fish. Raccoons and Common Crows are important predators on waterfowl during the breeding season, damaging both eggs and young. Muskrats enlarge ponds and guts and create new ones, and so improve waterfowl habitat. Marsh Hawks, Horned Owls and other raptors sometimes take a few ducks for food, but the total effect on waterfowl probably is insignificant. Three species of small fish, the common killifish (*Fundulus heteroclitus*), the striped killifish (*Fundulus majalis*), and the broad killifish (*Cyprinodon variegatus*) are common and widely distributed in tidal creeks and ponds.

## Invertebrates

Invertebrates are abundant and widespread. Mollusks, crustaceans and aquatic insects are predominant. The ribbed mussel (*Velosella demissa*) is the only common pelecypod or bivalve mollusk, and it is largely restricted to marginal areas along tidal creeks and ponds. A few colonies of a small clam (*Cyrenoida floridana*), are present locally. Two types of gastropod or univalve mollusks are abundant and quite generally distributed: the saltmarsh snail (*Melampus bidentatus*) and the tiny *Littoridinops* sp. Periwinkle snails (*Littorina irrorata*) are fairly common in marginal vegetation along creeks that are subject to considerable tidal fluctuation. Quite a variety of crustaceans are characteristic inhabitants. They include ostracod crustaceans (Ostracoda); copepod crustaceans (Copepoda); isopod crustaceans (Isopoda, including *Chiridotea coeca*, *Leptochelia savignyi*, and *Cyathura* sp.); amphipod crustaceans (Amphipoda, chiefly Gammaridae); and two types of decapod crustaceans, the mud crabs (Xanthidae) and the blue crab (*Callinectes sapidus*). The principal aquatic insects include mole crickets (*Gryllotalpa* sp.), nymphs of dragonflies (Libelluloidea), water boatmen (Corixidae), giant water bugs (Belostomatidae), larvae and pupae of mosquitoes (Culicidae, chiefly *Aedes sollicitans*), midge larvae (Chironomidae), predaceous diving beetles (Dytiscidae), water scavenger beetles (Hydrophilidae, including genera *Tropisternus*, *Berosus*, and *Enochrus*), and snout beetles (Curculionidae, chiefly *Calendra* sp.).

## Waterfowl

The brackish estuarine bay marshes are especially attractive to waterfowl during the spring and fall migration periods. The populations include Canada Geese and a considerable variety of dabbling ducks. The more characteristic species are:

### Primary Species

Black Duck	Blue-winged Teal
Green-winged Teal	American Widgeon

### Secondary Species

Canada Goose	Pintail
Mallard	Shoveler
Gadwall	Hooded Merganser

Other species of waterfowl occurring as casual or irregular visitors include the Whistling Swan, Snow Goose, Blue Goose, Redhead, Canvasback, Lesser Scaup, Common Goldeneye, Bufflehead, Ruddy Duck, Common Merganser, and American Coot.

Black Ducks and Green-winged Teal are quite generally distributed, but show a definite preference for creeks and ponds of the drain-

age systems in which marginal mud flats are exposed at low tide. American Widgeons and Gadwalls tend to concentrate on "stillwater ponds" that contain extensive beds of widgeongrass or muskgrass. Hooded Mergansers are nearly restricted to the larger tidal creeks, whereas Canada Geese prefer ponds of 5 acres or more. The other characteristic waterfowl species do not have well marked habitat preferences, although most of them seem to be somewhat more numerous on "stillwater ponds," either natural or artificial.

The "stillwater ponds" and shallow marshes often freeze over during the winter, and, when this happens, most of the waterfowl concentrate along ponds and creeks of the drainage systems, in areas where there is enough tidal current to keep the water open.

Comparatively large numbers of waterfowl breed in the brackish estuarine bay marshes. Black Ducks are quite generally distributed, occurring in all of the typical plant associations as well as in marginal upland habitats. Blue-winged Teal are common locally, being restricted almost entirely to portions of the marsh that contain extensive areas of marshmeadow. A very few scattered pairs of Gadwalls usually are present. An intensive study of breeding waterfowl populations was made from May 4 to 20, 1956, in a typical 1,000-acre tract in southern Dorchester County. The population contained 67 breeding pairs of ducks, including 53 pairs of Black Ducks, 13 pairs of Blue-winged Teal, and 1 pair of Gadwalls. Population densities were: Ducks of all species, 1 pair per 15 acres; Black Ducks, 1 pair per 19 acres; Blue-winged Teal, 1 pair per 77 acres; and Gadwalls, 1 pair per 1,000 acres. Ten of the Blue-winged Teal pairs were located in a single 160-acre sector of the study tract that contained extensive areas of marshmeadow.

Sample counts of transient and breeding waterfowl were made in Dorchester County in the period 1954-57 (table 10). The counts covered approximately 39 square miles along tidal creeks and guts. Waterfowl on stillwater ponds more than 1/8 mile away from the drainage systems were not counted, so American Widgeons and Gadwalls and certain other waterfowl were proportionally lower in the sample counts than they were in the habitat as a whole. In general, Black Ducks, Green-winged Teal, Blue-winged Teal and American Widgeons were the most abundant waterfowl during the migration periods. Waterfowl populations were more than six times as large in fall and early spring as in summer.

The gullet and gizzard food contents of 348 waterfowl collected in the brackish estuarine bay marshes were examined. Widgeongrass (leaves, stems, rootstalks and seeds) is taken in large quantities by nearly all species and is the most important waterfowl food in this habitat. The seeds of Olney three-square represent a major food for many waterfowl

species. Other plant foods that are fairly important include: hightide-bush (seeds), salt-marsh bulrush (seeds), and muskgrass. Seeds of twigrush also are frequently taken although this species ordinarily does not grow in brackish estuarine bay marshes. However, twigrush seeds are common in the windrows of vegetative debris along the creeks and ponds of the drainage systems; apparently, these seeds drift down from fresh estuarine bay marshes located on the upper watersheds of many of the tidal streams. Invertebrates commonly eaten by one or more kinds of ducks include the saltmarsh snail (*Melampus bidentatus*), the tiny gastropod *Littoridinops* sp., and copepods. Black Ducks often feed on small fish (chiefly Poeciliidae) in midwinter, but prefer larvae and pupae of mosquitoes (Culicidae) in summer.

### Waterfowl Harvest

The number of waterfowl bagged by members of the Elliott Marsh Gun Club from 1955 to 1958 is shown in table 11. The hunted area was a 700-acre tract of brackish estuarine bay marsh in southern Dorchester County. Six hundred and forty-eight waterfowl were taken during the 4-year period. One hundred and eighty-two of these were bagged in 1955, 203 in 1956, 112 in 1957, and 151 in 1958. The average number of waterfowl per man day was 2.3, varying from 1.7 in 1957 to 2.8 in 1955. American Widgeons and Black Ducks together made up 72% of the total, and Mallards made up 9% of the total.

### FRESH ESTUARINE BAY MARSHES

Fresh estuarine bay marshes (fig. 3) have developed on broad, shallow estuarine flats that are flooded by fresh or slightly brackish tidewaters. This habitat occupies about 30,000 acres in the Upper Chesapeake region. Differences in depth between mean low tides and mean high tides normally are quite narrow (1 to 1½ feet). The tidal streams of the drainage systems usually are broad and poorly defined and often merge imperceptibly into the numerous large connecting ponds. Marshes of this type occur mainly in two widely separated areas. The first area comprises approximately 16,400 acres in Dorchester County, Maryland. In this area, the marshes are along the upper portions of the Blackwater River and its two tributaries (Meekins Creek and Little Blackwater River), along the upper portion of Ireland Creek, and in the vicinity of Savannah Lake. The second area is in Baltimore and Harford Counties, Maryland. The marshes there occupy about 9,300 acres along the necks of land that extend into Chesapeake Bay. In a few other places, small marshes are scattered along the shores of Chesapeake Bay behind narrow barrier beaches.

### Vegetation

The characteristic plants of fresh estuarine bay marshes are:

#### Primary Species

Narrowleaf Cattail	Common Three-square
Sago Pondweed	White Waterlily
Dwarf Spikerush	Rosemallow
Olney Three-square	

#### Secondary Species

Muskgrass	Softstem Bulrush
Marsh Fern	Twigrush
Royal Fern	Duckweed ( <i>Lemna minor</i> )
Blue Cattail	Pickerelweed
Southern Cattail	Iris
Claspingleaf Pondweed	Dotted Smartweed
Widgeongrass	Coontail
Wildcelery	Pinnate Watermilfoil
Saltgrass	Slender Watermilfoil
Cyperus ( <i>C. filicinus</i> )	Water Pennywort
Common Spikerush	

Olney three-square dominates very extensive areas in Dorchester County and also is dominant in most other fresh estuarine bay marshes. It occurs in nearly pure stands or in associations with rosemallow and other subdominant species. It is predominant in broad zones closest to the drainage channels. Narrowleaf cattail, with its associated species, usually is restricted to areas where the water level is more stable. It is particularly common near the headwaters of the tributary streams and in areas along Chesapeake Bay that are protected by narrow barrier beaches. Common three-square usually dominates the marsh meadows that are frequent in the more shallow areas along the margins of the marsh. Common spikerush and other species, such as softstem bulrush, twigrush, iris, dotted smartweed, and marsh fern may be quite common locally in the marsh meadows.

Vegetation of the ponds and creeks is variable. Dwarf spikerush usually is common on mud bars or shallow flats that are often exposed at low tide. White waterlily, and occasionally water pennywort, make dense growth in ponds and creeks where the water level is relatively stable, as it often is toward the upper limits of the marsh. Submerged aquatic plants are comparatively scarce in the extensive marshes along the upper Blackwater River, because the water is darkened by organic stain, which reduces the penetration of sunlight. Sago pondweed is widely distributed in the marshes in Dorchester County except for the Blackwater River area. Other submerged species are common locally. Extensive beds of mixed species, including wildcelery, claspingleaf pondweed, sago pondweed, slender milfoil, and pinnate milfoil occur at Savannah Lake, one of the larger marsh ponds. A variety

of submerged aquatics also occur in the marshes along the "necks" of Baltimore and Harford Counties. Principal species include wildcelery, southern naiad, common waterweed, grassleaf pondweed, muckweed, coontail and muskgrass.

## Waterfowl

The characteristic species of waterfowl during the migration periods are:

### Primary Species

Canada Goose	Black Duck
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### Secondary Species

Whistling Swan	Shoveler
Mallard	American Widgeon
Gadwall	Ring-necked Duck
Pintail	Common Merganser
Green-winged Teal	American Coot
Blue-winged Teal	

Wintering and breeding populations of waterfowl in the fresh estuarine bay marshes usually are comparatively small. Wintering populations are extremely variable from year to year. During mild winters, fairly large populations are often present, whereas during severe winters, when most of the ponds and creeks freeze over, waterfowl are scarce or absent. Only a few scattered pairs of Black Ducks breed in the fresh estuarine bay marshes.

Canada Geese and Black Ducks are the two commonest waterfowl during the migration periods. Canada Geese come to the larger shallow ponds, particularly those that contain stands of Olney three-square and its associates. Black Ducks, Green-winged Teal and Blue-winged Teal are more numerous along ponds and creeks of the central drainage systems, where mud flats are exposed at low tide. Large numbers of Mallards and Pintails occasionally concentrate near managed draw-down impoundments and grain fields. Ring-necked Ducks (and occasionally other diving ducks) generally prefer the deeper ponds, whereas Whistling Swans, Gadwalls, American Widgeons, and American Coots prefer ponds with water that is clear enough to contain submerged plants.

Sample counts, covering approximately 6 square miles of habitat in Dorchester County, were made during the period 1946-57. Results are shown in table 12. Numbers probably are higher than they would be for the habitat as a whole, because most of the counts were made on Savannah Lake, which is unusually favorable for waterfowl.

The gullet and gizzard food contents of 28 waterfowl collected in fresh estuarine bay marshes of Dorchester County during the

migration periods were examined. The most important plant foods were twigrush (seeds), Olney three-square (seeds and rootstalks), common three-square (rootstalks), clasping-leaf pondweed (leaves and rootstalks) and widgeongrass (leaves and rootstalks). Animal foods of some importance, particularly to Black Ducks, include killifish (*Fundulus* sp.), amphipod crustaceans (Gammaridae), and midge larvae (Chironomidae).

## ESTUARINE RIVER MARSHES

Estuarine river marshes have become established wherever tidewaters have extended inland from the broad estuarine bays along narrowed valley floors of tributary streams. This habitat occupies about 67,000 acres in the Upper Chesapeake region. Because the channels become progressively narrower inland, variation in tide levels usually is greater than it is farther out toward the bay. Estuarine river marshes of various sizes are scattered throughout the Upper Chesapeake region. The largest, along the Nanticoke River, is as much as 2 miles wide in places. Other large marshes are along the Patuxent, Elk, Chester, Choptank, Transquaking, Chicamacomico, Wicomico (Wicomico Co., Maryland) and Pocomoke Rivers. Small marshes are along numerous small tidal streams.

## Vegetation

Vegetation varies from one area to another. The major differences are produced by differences in salinity.

The largest area of fresh estuarine river marsh is along the Patuxent River, above the mouth of Lyons Creek. Other fairly large areas are along various tributaries of the Potomac River between the District of Columbia and Potomac Creek; on the Elk River; and along the upper tidewater portions of the Choptank and Wicomico Rivers (Wicomico River of Wicomico County).

The vegetation of typical fresh-water areas is composed of a great variety of emergent marsh plants, including many species that occur in the interior beyond tidewater. Characteristic species include:

### Primary Species

Narrowleaf Cattail	Dotted Smartweed
Broadleaf Arrowhead	Halberdleaf Tearthumb
Rice Cutgrass	Tidemarth Waterhemp
Wildrice	Spatterdock
Walter Millet	Jewelweed
River Bulrush	Rosemallow
Arrow-arum	Marsh Beggartick
Pickerelweed	

### Secondary Species

Marsh Fern	Tussock Sedge
Royal Fern	Sedge ( <i>Carex crinita</i> )
Broadleaf Cattail	Sweetflag
Blue Cattail	Smooth Alder
Giant Burreed	Arrowleaf Tearthumb
Common Burreed	Coontail
Ribbonleaf Pondweed	Swamp Rose
Common Waterweed	Winterberry
Wildcelery	Waterparsnip
Phragmites	Silky Dogwood
Common Spikerush	Swamp Milkweed
Common Three-square	Dodder
Softstem Bulrush	Buttonbush
Woolgrass	Climbing Hempweed

The major dominant plants are wildrice, river bulrush, pickerelweed, and spatterdock.

Local variations in species composition appear to be correlated with differences in depth of water. Certain broad-leaved emergents, such as spatterdock, pickerelweed and arrow-arum are especially characteristic of the deeper portions of the marsh near open water. Many species, including rice cutgrass, Walter millet, river bulrush, dotted smartweed, halberdleaf tearthumb, tidemarsch waterhemp, jewelweed, and marsh beggartick are typical of shallow marginal areas. Wildrice in nearly pure stands, or in mixtures with various species, dominates the larger intervening sectors of intermediate depth.

Typical brackish estuarine river marshes are quite extensive in the Upper Chesapeake region. The characteristic plants of brackish estuarine river marshes are:

### Primary Species

Narrowleaf Cattail	Olney Three-square
Big Cordgrass	Dotted Smartweed
Switchgrass	Rosemallow

### Secondary Species

Grassleaf Pondweed	Arrow-arum
Common Waterweed	Pickerelweed
Saltgrass	Swamp Dock
Phragmites	Atriplex
Saltmarsh Cordgrass	Tidemarsch Waterhemp
Saltmeadow Cordgrass	Saltmarsh Mallow
Walter Millet	Groundselbush
Dwarf Spikerush	Saltmarsh Fleabane
Common Three-square	Hightide-bush
Twigrush	

Big cordgrass is dominant in nearly all areas. It may be in nearly pure stands or mixed with various subdominant plants. Stands of big cordgrass may be interspersed locally with plant associations dominated by narrowleaf cattail, Olney three-square, or switchgrass. Big cordgrass also is the dominant plant in areas that are intermediate between fresh and brackish marshes. In the areas of inter-

mediate salinity, the plants growing with big cordgrass are a mixture of fresh and brackish species. Small pockets of fresh marsh occur within many of the brackish marshes near the headwaters of the various tidal tributary streams.

### Birds Other Than Waterfowl

Fresh estuarine river marshes are especially famous for their large numbers of Sora in the fall. They also attract myriads of Bobolinks, Red-winged Blackbirds, Common Snipes, and many other marsh-inhabiting birds. Typical brackish estuarine river marshes usually are comparatively barren of birdlife.

### Waterfowl

Characteristic species of waterfowl in the estuarine river marshes during the spring and fall migration periods are:

### Primary Species

Mallard	Green-winged Teal
Black Duck	Blue-winged Teal
Pintail	Wood Duck

### Secondary Species

Canada Goose	Hooded Merganser
American Widgeon	Common Merganser
Ring-necked Duck	American Coot

Species occasionally recorded as casual or irregular visitors include the Whistling Swan, Gadwall, Shoveler, Redhead, Common Goldeneye, and Ruddy Duck.

Large numbers of dabbling ducks congregate in fall and spring because of the abundant food. Waterfowl usually are rather scarce in winter, probably because the marshes frequently freeze over. A few Wood Ducks nest along the wooded upland margins, and a few pairs of Black Ducks breed locally.

The greatest concentrations of waterfowl are in areas that are intermediate between fresh and brackish types. These areas have excellent cover and abundant food. Fresh-water areas also have abundant food but little suitable cover. Brackish marshes have little food but ample cover. Only Black Ducks are most numerous in the brackish areas.

Sample boat counts of transient and wintering waterfowl populations in estuarine river marshes are shown in table 13. Counts covered approximately 44 square miles of habitat.

The gullet and gizzard food contents of 79 waterfowl collected in estuarine river marshes during spring and fall were examined. Dotted smartweed (seeds) is the outstanding food plant. Other foods occasionally taken in fairly large amounts include the seeds of common

burreed, wildrice, Walter millet, common three-square, softstem bulrush, river bulrush, and halberdleaf tearthumb. Arrow-arum (seeds) was the all-important Wood Duck food and giant burreed (seeds) and halberdleaf tearthumb (seeds) were taken in fairly large quantities.

## WOODED BOTTOMLANDS

Wooded bottomlands border the various streams of the coastal plain interior. The bottomlands along the Patuxent River were selected for study as a sample of the habitat. The area within the Patuxent Wildlife Research Center (between Bowie and Laurel, Maryland), was studied most intensively. Other observations were made along the Patuxent River from the fall line (natural boundary between Piedmont and Coastal Plain) down the river valley for approximately 23 miles, nearly to the upper limits of tidewater. A few general surveys were made along other streams within the Upper Chesapeake region.

### Vegetation

The vegetation of the wooded bottomlands on the Patuxent Wildlife Research Center was described in detail by Hotchkiss and Stewart (1947), so only the aquatic plants will be discussed here.

Aquatic plants that are fairly common in scattered patches in the river proper include ribbonleaf pondweed, riverweed, Nuttall waterweed, nitella, and filamentous green algae. Only shade-tolerant plants grow commonly in the shallow runs on the flood plain. These include a species of aquatic moss (*Fontinalis* sp.), quillwort, common burreed, ribbonleaf pondweed, broadleaf arrowhead, waterplantain, eastern mannagrass, goldenclub, swamp smartweed, spatterdock, Pennsylvania bittercress, water-starwort, and mermaidweed.

### Vertebrates Other Than Waterfowl

Certain species of fish are fairly common in the river: the red-sided dace (*Clinostomus vandoisulus*), fallfish (*Semotilus corporalis*), common shiner (*Notropis cornutus*), Johnny darter (*Etheostoma nigrum*), and yellowbelly sunfish (*Lepomis auritus*). Eastern redbreast suckers (*Moxostoma macrolepidotum*) migrate upstream in good-sized schools in late winter and early spring. Other species of fish characteristic of more sluggish waters live in the deeper pools in the runs back on the flood plain. These include the American eel (*Anguilla rostrata*), pirate-perch (*Aphredoderus sayanus*), redfin pickerel (*Esox americanus*), chain pickerel (*Esox niger*), pumpkinseed sunfish (*Lepomis gibbosus*), golden shiner (*Notemigonus crysoleucas*), and mud minnow

(*Umbra pygmaea*). Frogs and salamanders congregate in bottomland pools to breed. Several species of reptiles live in the wooded bottomlands, including the snapping turtle (*Chelydra serpentina*), which occasionally preys on waterfowl. The more important mammalian predators that travel along the margins of the water courses are: the raccoon (*Procyon lotor*), mink (*Mustela vison*), and gray fox (*Urocyon cinereoargenteus*). The common raptorial birds are the Red-shouldered Hawk and the Barred Owl.

### Invertebrates

Many species of aquatic invertebrates inhabit the Patuxent River and the smaller runs of the flood plain. Pelyceid mollusks that are common include the river clam (*Elliptio complanatus*) and two much smaller species, *Pisidium atlanticum* and *Sphaerium* sp. Small gastropod mollusks that occur regularly are: *Ambloxis decussatus*, *Gyraulus* sp., and *Physa* sp. Crayfish (*Cambarus* sp.) are fairly numerous. The larvae and adults of numerous species of aquatic insects are present. Principal insect groups include: Odonata (dragonflies and damselflies), Gerridae (water striders), Corixidae (water boatmen), Trichoptera (caddisflies), Dytiscidae (predaceous diving beetles), Gyrinidae (whirligig beetles), Curculionidae (snout beetles), Culicidae (mosquitoes), and Chironomidae (midges).

### Waterfowl

The principal transient waterfowl include Wood Ducks (approximately 40% of the total), Mallards (30%), Black Ducks (20%), and Hooded Mergansers (5%). Waterfowl that make up the remaining 5% are: Pintails, Green-winged Teal, Blue-winged Teal, American Widgeons, Ring-necked Ducks, Common Goldeneyes, Buffleheads and Common Mergansers.

In general, greater numbers of waterfowl frequent the wider sections of the river than the narrow branches or the flood-plain runs. Hooded Mergansers differ from other species in that they are restricted to the river, and seem to show little preference between wide portions and the more narrow branches.

Numbers of transient waterfowl vary greatly from year to year. Numbers of migrating Mallards, Black Ducks and Wood Ducks seem to be correlated with the abundance of the local mast crop, particularly beechnuts and the acorns of pin oak and white oak. In years of low mast production, there seldom are more than 20 birds per square mile of flood-plain forest. During years with bumper mast crops, there may be 50 to 100 birds per square mile of habitat. Flock size also generally is larger during years when mast is abundant; many flocks will have 10 to 25 birds. Large numbers of ducks take refuge in the bottomlands during

severe stormy weather. At these times, many flocks will have from 50 to 100 ducks.

The gullet and gizzard food contents of 101 transient waterfowl collected in wooded bottomlands along the Patuxent River were examined. Beechnuts and the acorns of pin oak and white oak are the preferred foods of Wood Ducks, Mallards, and Black Ducks. Other fruits and seeds that are important, particularly during years of low mast production, include hornbeam, poison-ivy, grape, black-gum, sweetgum, halberdleaf tearthumb, and dotted smartweed. Fairly large quantities of leaves and stems of ribbonleaf pondweed and Nuttall waterweed occasionally are eaten. Small mollusks are a supplementary food for Black Ducks, and, to a lesser extent, for Mallards. Fish and crayfish (*Cambarus* sp.) apparently are the principal foods of Hooded Mergansers in this habitat.

Wintering waterfowl usually are scarce in the wooded bottomlands. Breeding populations usually are composed of a few scattered pairs of Wood Ducks.

## INTERIOR IMPOUNDMENTS

Artificial impoundments are scattered throughout the coastal plain interior of the Upper Chesapeake region. These were made by constructing dams or dikes to impound streams or the run-off waters of small watersheds. Most of these ponds are rather small, usually from 1 to 30 acres. A few larger ones may cover as much as 100 acres. Most of the ponds are managed for fishing or are used as watering ponds for livestock. A few are managed specifically for waterfowl. These include several at the Patuxent Wildlife Research Center. Construction and management procedures are described by Uhler (1956). Artificial impoundments in New Jersey were studied by McLain (1957).

## Vegetation

The vegetation of interior impoundments usually includes a large number of species. The species can be grouped according to three major zones: open-water, shore-line and drawdown. Table 14 shows many of the characteristic plants of each of these zones as they occur in the impoundments at the Patuxent Wildlife Research Center. Waters of most artificial ponds are acid, sometimes strongly acid, and contain no choice submerged food plants. Plant foods of open-water and shore-line zones are used by waterfowl, but they are not first-rate waterfowl foods. The drawdown zone, which is produced by summer drainage to expose mud flats, results in the growth of a large number of important waterfowl food plants. Reflooding in October when the seeds have matured makes food available

for waterfowl. Certain pest plants, including common beggartick and pilewort, are held in better check by a biennial drawdown.

## Vertebrates Other Than Waterfowl

Numbers and kinds of vertebrates using artificial impoundments vary greatly because of variations in relative fertility of the waters, depth and size of the ponds, and the type of pond management. The more characteristic fish, including several species that often are stocked, are: the chain pickerel (*Esox niger*), largemouth black bass (*Micropterus salmoides*), Pumpkinseed sunfish (*Lepomis gibbosus*), bluegill sunfish (*Lepomis macrochirus*), black crappie (*Pomoxis nigromaculatus*), golden shiner *Notemigonus crysoleucas*, and mud minnow (*Umbra pygmaea*).

## Invertebrates

A great variety of invertebrates, particularly aquatic insects, occur in some artificial ponds. The more numerous and widespread types are:

Isopod Crustaceans (*Asellus* sp.)  
 Amphipod Crustaceans (Gammaridae)  
 Watermites (Hydrachnellae)  
 Mayfly Nymphs (Ephemeroptera)  
 Damselfly Nymphs (Zygoptera)  
 Dragonfly Nymphs (Anisoptera)  
 Water Striders (Gerridae)  
 Water Scorpions (Nepidae)  
 Giant Water Bugs (Belostomatidae)  
 Back Swimmers (Notonectidae)  
 Water Boatmen (Corixidae)  
 Alderfly larvae (Sialidae)  
 Caddisfly larvae (Trichoptera)  
 Predaceous Diving Beetles (Dytiscidae)  
 Whirligig Beetles (Gyrinidae)  
 Water Scavenger Beetles (Hydrophilidae)  
 Snout Beetles (Curculionidae)  
 Mosquito larvae (Culicidae)  
 Midge larvae (Chironomidae)  
 Horsefly larvae (Tabanidae)

## Waterfowl

The characteristic species of transient waterfowl of interior impoundments are:

### Primary Species

Canada Goose	Pintail (local)
Mallard	Ring-necked Duck
Black Duck	

### Secondary Species

Green-winged Teal	Common Goldeneye
Blue-winged Teal	Bufflehead
American Widgeon	Ruddy Duck
Wood Duck	Hooded Merganser
Redhead	Common Merganser
Lesser Scaup	American Coot

Other species, occasionally recorded as casual visitors, include: Whistling Swan, Blue Goose, Gadwall, Shoveler, Canvasback, Greater Scaup, Oldsquaw, White-winged Scoter, and Red-breasted Merganser.

Most waterfowl prefer impoundments managed by the summer drawdown technique. Common Goldeneyes, Buffleheads, Hooded Mergansers, and Common Mergansers may be exceptions. Large numbers of Canada Geese, Mallards, Black Ducks, and Pintails often use interior impoundments for resting sites when the impoundments are near important feeding grounds, such as large grain fields or extensive tidal marshes. Canada Geese and American Widgeons also frequently forage on nearby pastures and hayfields. Canada Geese and dabbling ducks rarely use ponds without drawdown zones unless grainfields or other good areas are nearby. Diving ducks and mergansers occasionally come to ponds without drawdown zones. Spectacular concentrations of Mallards, Black Ducks, and Wood Ducks occasionally roost in artificial ponds that contain fairly dense stands of trees and shrubs.

Wintering waterfowl populations usually are sparse on most interior impoundments because of the ice. Wood Ducks breed on the ponds in most areas where nest boxes are provided. Small breeding populations of introduced Canada Geese, Mallards, and Black Ducks also have become established locally with the help and surveillance of game managers and biologists.

Sample counts of waterfowl were made on two adjoining interior impoundments on the Patuxent Wildlife Research Center. During the full pool stage, the two ponds covered approximately 95 acres. The ponds were drawn down during alternate years. Data from several counts (selected to show variation in species composition) are shown in table 15.

The gullet and gizzard food contents of 54 waterfowl collected from interior impoundments were examined. In general, dabbling ducks preferred vegetable foods and diving ducks preferred animal foods. A more detailed discussion of foods is included with the species accounts.



## BIOGEOGRAPHICAL SECTIONS

Local differences in waterfowl populations within the Upper Chesapeake region often are closely correlated with local variations in the preponderance of various types of waterfowl habitat. Fifteen biogeographical sections were defined on the basis of kinds and proportions of habitats and abundance and kinds of waterfowl. The sections are mapped in figure 4.

The proportion of waterfowl wintering in each section (table 16) was calculated from the January inventory data. Three-fifths of the entire population was found in four contiguous sections along the eastern shore of Chesapeake Bay, (Chester River, Eastern Bay, Choptank River, and Blackwater-Nanticoke sections). About one-sixth of the population was distributed over the large area lying south of the Patapsco River along the western shore of Chesapeake Bay and in the Patuxent and Potomac River sections. The remaining populations (approximately one-fourth of the total) were about equally divided between the freshwater areas of the north Chesapeake (Upper Western Shore, Susquehanna Flats, and Upper Eastern Shore sections) and the lower salt-water areas (Lower Eastern Shore and Coastal sections). The outstanding local concentrations were in the Chester River section, where more than one-fifth of the entire Upper Chesapeake population was found.

Sections that contained numerous large agricultural fields adjacent to open estuarine waters or marsh had large numbers of Canada Geese, Mallards, Black Ducks, and Pintails. Sections that had great expanses of estuarine bay marsh had large numbers of many kinds of dabbling ducks and moderately large numbers of geese. Sections containing fresh or brackish estuarine bays with extensive shoal-water areas had many diving ducks and Whistling Swans. In sections that contained large areas of fresh or slightly brackish habitats, extensive icing sometimes drastically reduced waterfowl numbers in winter. Many local areas were unsuitable for waterfowl because of pollution, turbidity, and excessive human disturbance.

Information concerning seasonal changes in distribution of transient and wintering waterfowl came from aerial census data of the 1958-59 season (table 17). The winter of 1958-59 was unusually severe, so the January counts may be atypical. The Chester River section and the Eastern Bay and Choptank River sections were important waterfowl areas from fall to spring. The Susquehanna Flats were important to waterfowl during the spring and fall migration periods but had comparatively few birds during the winter.

Each of the biogeographical sections will be discussed separately.

### UPPER POTOMAC SECTION

#### Habitats

The Upper Potomac section is primarily a fresh estuarine bay that is adjoined by a few small fresh estuarine river marshes and a few stretches of river bottomland. This section once had extensive beds of wild celery, naiad, and sago pondweed and lush stands of wildrice, dotted smartweed and other river marsh species. Most of the marshes now have been eradicated to make way for airfields or building sites. The river itself is so heavily polluted and silted that the upper half of the section (between Washington, D. C., and Chicamuxen Creek in Charles County, Maryland) is completely devoid of submerged vascular plants.

#### Waterfowl

The Upper Potomac section formerly was one of the best waterfowl areas in the Upper Chesapeake region, with many thousands of dabbling ducks and diving ducks. Now the greatly reduced populations are largely restricted to the areas below Chicamuxen Creek, where fairly large beds of submerged plants still occur. The effects on waterfowl of the gradual deterioration of the upper Potomac estuary are vividly described by Slavik and Uhler (1951), and Linduska (1959).

January inventory data during the years 1955-58 showed that the Upper Potomac wintering population of waterfowl ranged from 2,600 in 1957 to 10,300 in 1956, and averaged 6,400. Proportions of the various species at different seasons are shown in table 18. Largest populations were present during late fall and early spring, when Black Ducks, Canvasbacks, and Ruddy Ducks were most numerous. Mallards, Black Ducks, and Canvasbacks were predominant in winter.

### CENTRAL POTOMAC SECTION

#### Habitats

The Central Potomac section has extensive shoal waters of slightly brackish estuarine bay where there are great beds of submerged aquatic plants. The section also contains several fair-sized estuarine river marshes.

#### Waterfowl

This section is the best waterfowl area in the western portion of the Upper Chesapeake region. January inventory data during the

years 1955-1958 show that the wintering population of waterfowl ranged from 10,900 in 1957 to 77,300 in 1955, and averaged 48,500. During the 1958-59 season waterfowl numbers reached their peak during late fall.

Proportions of the different species are shown in table 19. Diving ducks were more numerous in late fall, winter, and early spring. Dabbling ducks predominated during the early fall flight. Canvasbacks and Ruddy Ducks were the most abundant in winter, making more than half of the population. American Widgeons were of primary importance during the early fall flight, but rapidly declined thereafter. Other important transients during both fall and spring flights included the Canvasbacks, Ruddy Ducks, American Coots, and scaup. The Central Potomac section is the only area within the Upper Chesapeake region where there normally are fairly large populations of Gadwalls.

## LOWER POTOMAC SECTION

### Habitats

The open estuarine bays are the most important habitats in the Lower Potomac section, although the shoal-water zones containing submerged vegetation are narrow and quite limited. The lower part of the Potomac estuary, from the mouth of the river to Piney Point on the Maryland side and Sandy Point on the Virginia side, and including the Coan, St. Marys, and Yeocomico Rivers, is a moderately saline estuarine bay. The portion of the estuary above this area extending to Cobb Island on the Maryland side and Pope Creek on the Virginia side, and including Breton, St. Clement, and Nomini Bays, is typically brackish. Other habitats are of minor importance in this section and quite restricted in size. Small areas of salt estuarine bay marsh are scattered along the river, the largest on St. George Island. Occasional patches of brackish estuarine river marsh also are present along some of the smaller tributaries. Locally, and especially in the St. Marys River area, large grain fields border the shores of the estuaries.

### Waterfowl

There are comparatively few waterfowl in the Lower Potomac section. The majority are diving ducks and other open-water species. Good-sized flocks of Canada Geese, and smaller numbers of dabbling ducks, occur locally near grain fields. Counts made in the January inventory, 1955-58, ranged from 2,600 in 1956 to 60,800 in 1955, averaged 32,000. During the 1958-59 season, the peak population was reached in mid-winter and was maintained at a high level through early March.

Proportions of the different species are shown in table 20. Canada Geese and American Widgeons made up the greater part of the early fall flight of waterfowl. The diving ducks were especially important in late fall, winter, and early spring. The principal waterfowl species were Canvasbacks, Redheads, scaup, Common Goldeneyes, Buffleheads, Oldsquaws, and Ruddy Ducks.

## PATUXENT RIVER SECTION

### Habitats

The principal habitats in the Patuxent River section are the open estuarine bays between the mouth of the river and Deep Landing, and the estuarine river marsh extending about 17 miles from Deep Landing to a point  $1\frac{1}{2}$  miles above Hills Bridge. The fresh-water portion of the marsh is the largest of its type in the Upper Chesapeake region, occupying a little more than 2,000 acres (including the river channel).

The open estuarine bays include two fairly distinct sectors. Water is moderately saline from the mouth of the river upstream to Point Patience. Sago pondweed and the more characteristic salt-water species grow in this sector. The estuarine bay above Point Patience is typically brackish. It contains fairly large beds of submerged vegetation, except for the portion above Swanson Creek, where turbidity is great enough to limit the development of aquatic plants. The estuarine river marsh has three natural sectors: a brackish portion, from Deep Landing to (but not including) Hall Creek; a transitional brackish-fresh area, from Hall Creek to Lyons Creek; and a fresh portion, above Lyons Creek.

### Waterfowl

A great variety of diving ducks and dabbling ducks occur regularly in this section. The total populations, however, are lower than would be expected, judging by the excellent habitat conditions throughout. Excessive hunting pressure and other human disturbance may be responsible for the apparent discrepancy between habitat conditions and numbers of waterfowl.

January inventory data during the years 1955-58 show that the wintering population ranged from 4,100 in 1958 to 72,100 in 1956, averaged 29,900. During the 1958-59 season, the population peak (14,800) was reached in late fall.

Proportions of the different species are shown in table 21. Canvasbacks and scaup were the principal wintering waterfowl. Fairly large numbers of Whistling Swans, Mallards, Black Ducks, Redheads, Common Goldeneyes, Buffleheads, Ruddy Ducks, and American Coots

also were present. Additional species present in considerable numbers during the spring and fall migration included Pintails, Green-winged Teal, Blue-winged Teal, American Widgeons and Wood Ducks. The population figures for Green-winged Teal, Blue-winged Teal, and Wood Ducks are misleadingly low because these species are especially difficult to count from the air and therefore are frequently overlooked.

Diving ducks generally are restricted to the open estuarine bays, whereas dabbling ducks are more numerous in the estuarine river marshes. Certain species are exceptions. For example, American Widgeons generally are more common on the open estuarine bays, whereas Ring-necked Ducks prefer the river marshes.

Lesser Scaup, Common Goldeneyes, Buffleheads and Oldsquaws are especially numerous in the lower, moderately saline portion of the open estuarine bay during the wintering and migration periods. Canvasbacks, Redheads, Lesser Scaup, and Ruddy Ducks usually are predominant in the brackish portion of the bay. Fairly large numbers of Black Ducks and American Widgeons occasionally occur in some of the more sheltered coves.

Dabbling ducks may concentrate locally in the estuarine river marshes, especially during the migration periods. Ordinarily, they are most numerous in the transitional brackish-fresh areas where there are excellent cover and abundant food. Mallards usually are predominant in these brackish-fresh areas. Other common waterfowl include Black Ducks, Pintails, Green-winged Teal, Blue-winged Teal, and Wood Ducks. Waterfowl often travel back and forth between the transitional and fresh-water marshes during the late evening and early morning flights. The species in these two types of marsh therefore are similar. Fewer birds are present in the fresh-water portion during the daylight hours, however, apparently because of the scarcity of adequate cover. Waterfowl usually are comparatively scarce in the brackish portion of the estuarine river marsh, although Black Ducks occasionally may be fairly numerous.

## LOWER WESTERN SHORE SECTION

### Habitats

The Lower Western Shore section consists entirely of relatively deep salt estuarine bays. The bays are bordered by an exposed steep shoreline that frequently is subjected to severe wave action. This environment is not suitable for the establishment of extensive beds of submerged plants.

### Waterfowl

Most species of waterfowl are comparatively scarce throughout the section. Large numbers

of diving ducks do occasionally move in when more favorable areas are icebound.

January inventory data during the years 1955-58 show that the wintering population ranged from 100 birds in 1957 to 6,700 in 1958, averaged 2,900. The very high number (71,500) recorded during the January coverage of the 1958-59 season probably was the result of the unusually severe weather that winter. Proportions of the different species are shown in table 22. Waterfowl that occasionally are fairly numerous include scaup, Common Goldeneyes, Buffleheads, Oldsquaws, scoters, and Canvasbacks.

## CENTRAL WESTERN SHORE SECTION

### Habitats

The brackish estuarine bay is the prevalent habitat type in the Central Western Shore section. This habitat is at its best within the numerous sheltered coves, bays, and inlets, where there are great beds of submerged plants. There also are small areas of slightly brackish estuarine bay in the upper portions of the Magothy and Severn Rivers. Herring Bay is a moderately saline type of salt estuarine bay.

### Waterfowl

Waterfowl are relatively scarce in this section because of excessive disturbance by the large human populations. Habitat conditions are excellent, especially for diving ducks and swans.

January inventory data during the years 1955-58 show that the wintering population ranged from 10,800 in 1956 to 58,000 in 1955, averaged 34,900. During the 1958-59 season, the January population was down to 8,300 apparently as a result of severe weather. This was followed by a peak population of 24,000 in March.

Proportions of the different species are shown in table 23. American Widgeons, Ruddy Ducks, and American Coots are the most numerous waterfowl during the early fall flight. Canvasbacks and Whistling Swans, and frequently scaup, are dominant during late fall and winter. Lesser Scaup are the most abundant waterfowl during early spring, but there also are large numbers of Canvasbacks and Ruddy Ducks.

## UPPER WESTERN SHORE SECTION

### Habitats

Fresh and slightly brackish estuarine bays are the more extensive habitats in the Upper Western Shore section. The fresh estuarine

bays extend from Spesutie Island to Gunpowder Neck; they include the Bush River estuary and the upper half of the Gunpowder River estuary (see map, fig. 3). The slightly brackish estuarine bays extend from Gunpowder Neck to Bodkin Island; they include the lower half of the Gunpowder River estuary and the Middle, Back, and Patapsco Rivers estuaries.

This section also contains fairly large areas of tidal marsh. There are three major types. Fresh estuarine bay marshes occur on the "necks" extending into Chesapeake Bay between Spesutie Island and the Middle River. A large fresh estuarine river marsh is located at the upper limits of the Patapsco River estuary. It has been modified somewhat by earth fill and trash disposal. Smaller fresh estuarine river marshes lie along the upper Bush and Gunpowder estuaries. Small brackish estuarine river marshes occur along streams near the outer bay shore in a few scattered areas between Gunpowder Neck and Bodkin Island.

Food plants are abundant throughout the greater part of this section. Locally, industrial pollution has caused extensive damage to submerged plants. Small beds of the introduced waterchestnut and Eurasian watermilfoil have become established recently. Unless these plants are eradicated soon, they probably will spread and crowd out natural beds of submerged vegetation.

## Waterfowl

Many transient diving ducks and Whistling Swans occur in this section, as do fairly large numbers of transient dabbling ducks. Numbers of wintering waterfowl vary greatly from year to year, depending on the weather. Human disturbance, in the form of excessive boating and artillery firing on the military reservations, appears to be increasing. Disturbance may be responsible for the reduction in waterfowl populations noticeable during recent years.

January inventory data during the years 1955-58 show that the wintering population ranged from 4,000 in 1956 to 58,100 in 1955, averaged 34,400. During the 1958-59 season, the population peak was reached in late fall.

Proportions of the different species are shown in table 24. Ruddy Ducks are predominant. Other waterfowl that are fairly abundant include Canvasbacks, Redheads, scaup, Whistling Swans, and Canada Geese.

## SUSQUEHANNA FLATS SECTION

### Habitats

The fresh estuarine bay habitat is at its best in this section and is the only extensive habitat. Tremendous beds of a variety of

submerged plants are widespread through the section.

## Waterfowl

Great numbers of transient waterfowl concentrate on the Susquehanna Flats and the adjoining estuary, the Northeast River. The huge flocks of Canvasbacks sometimes contain nearly half of the total continental population of the species. Large numbers of other diving ducks, and many swans, geese, dabbling ducks, and coots stop in this area during migration. Boating and hunting both have increased in recent years, and, as a result, most waterfowl do not remain in the area as long as they did formerly.

January inventory data during the years 1955-58 show that numbers of wintering waterfowl at the Susquehanna Flats ranged from 1,500 in 1956 to 72,300 in 1955, averaged 28,400. This extreme variation is largely a reflection of changes in ice conditions on the flats from year to year. Proportions of the different species are shown in table 25. During the 1958-59 season, the early December population was unusually low and probably was correlated with the abnormally low temperatures at that time. Peak population numbers are reached during late November and early December of most years. On December 7, 1947, more than 100,000 Canvasbacks and 25,000 scaup were counted (with the aid of a telescope) from three observation points along the shore; by December 20, only 44,000 Canvasbacks could be counted and scaup had disappeared entirely.

American Widgeons are the principal waterfowl in the Susquehanna Flats section during the early fall flight in October. Fairly large numbers of Pintails (500 to 10,000) also arrive on the flats during September, and frequently remain through the early part of October. Redheads and Canvasbacks usually are predominant during late fall and winter, when fairly large numbers of Whistling Swans, Canada Geese, Black Ducks, Common Goldeneyes and Buffleheads also are present. Redheads, Canvasbacks, and Lesser Scaup are the commonest waterfowl in spring. American Coots often are common in late March and April, and occasionally are fairly common in the fall. Shore counts from numerous observation points showed a total of 11,400 American Coots on March 31, 1955.

## UPPER EASTERN SHORE SECTION

### Habitats

The principal areas of the Upper Eastern Shore section are the fresh-water estuarine bays of the Sassafraz, Elk, and Bohemia Rivers. The river waters are quite turbid or heavily silted so that there are relatively few

extensive beds of submerged aquatic plants except in the shallower zones near the shores. Exposed stretches of slightly brackish estuarine bays occur along the shores of Chesapeake Bay below the Sassafras River. Submerged plants are somewhat scarce in this area because of severe wave action. A few estuarine river marshes, of the fresh and transitional fresh-brackish types, are scattered throughout the section. The largest river marsh is at the head of the Elk River estuary, below Elkton.

The Upper Eastern Shore section is in a heavily agricultural area, where large grain fields are adjacent to most of the natural habitats.

## Waterfowl

Canada Geese are the principal waterfowl. Most of them are in or near the Sassafras River, especially in the Turner Creek area. Many also concentrate in the Bohemia River area. Mallards, Black Ducks, American Widgeons, and Canvasbacks are common in various areas of this section, but other species are comparatively scarce.

January inventory data during the years 1955-58 show that the wintering population ranged from 30,100 in 1958 to 138,700 in 1955, averaged 61,800. Periodic surveys during the 1958-59 season show that the population peak (50,000) was reached in early spring.

Proportions of the different species are shown in table 26. Canada Geese made up more than half of the waterfowl population throughout the survey period. Dabbling ducks were commonest during the fall and early spring, when good-sized flocks of Mallards and Black Ducks were present. Occasionally, fair numbers of Green-winged Teal, Blue-winged Teal, and Wood Ducks were recorded in some of the estuarine river marshes.

## CHESTER RIVER SECTION

### Habitats

The principal habitat of the Chester River section is the brackish estuarine bay of the lower Chester River. The tidewaters in this section are somewhat fresher than the tidewaters in otherwise similar areas of Eastern Bay and Choptank River sections. Brackish estuarine bay marshes are scattered along the lower portion of the river, and brackish estuarine river marshes along the more narrow upper stretch.

The great beds of submerged aquatic vegetation are not far from large fields of corn, wheat, barley, rye, and soybeans in the adjoining farmlands. Artificial ponds also are present on many of the farms.

## Waterfowl

The Chester River section is the most important waterfowl area in the entire Upper Chesapeake region.

January inventory data during the years 1955-58 show that the wintering population ranged from 75,800 in 1958 to 399,800 in 1955, averaged 200,800. During the 1958-59 season, the population peak (208,700) was reached in late fall. Proportions of the various species at different seasons are shown in table 27. The greatest populations of most species were found during late fall and winter. Geese and dabbling ducks together made up more than three-fourths of the Chester River populations. Black Ducks were common throughout the survey period. Canada Geese and Mallards were common during late fall, winter, and early spring; Pintails throughout fall and early spring; American Widgeons during the early fall; and Canvasbacks in winter.

Canada Geese, Mallards, and Black Ducks usually are abundant where the open estuarine bays adjoin fields. Pintails are often numerous also. Whistling Swans, American Widgeons, and Canvasbacks are common and generally distributed in the brackish estuarine bay, to which they usually are restricted. Large local concentrations of dabbling ducks of various species occur in the brackish bay and river marshes. Canada Geese, Mallards, and Pintails often rest or roost on the artificial impoundments of the farms. Mallards are more abundant in the Chester River section than in the similar parts of the Eastern Bay or Choptank sections, perhaps because of fresher water, or perhaps because thousands of game-farm Mallards are released each year at Remington Farms in Kent County. Black Ducks commonly breed in this section during late spring and summer. Most of them are in the lower portion of the Chester River along the margins of the brackish estuarine bay and in the scattered brackish estuarine bay marshes.

## EASTERN BAY SECTION

### Habitats

The principal habitat of the Eastern Bay section is a large shallow estuarine bay, typically brackish, that contains an abundant growth of submerged plants. Several fair-sized tracts of brackish estuarine bay marsh are present along the margins of the bay. The area is surrounded by extensive agricultural lands.

## Waterfowl

This section is an important concentration area for a considerable variety of waterfowl.

January inventory data during the years 1955-58 show that the wintering population ranged from 40,100 in 1958 to 232,800 in 1956, averaged 135,300. The population peak is reached in winter, although large populations also are present in late fall and early spring.

Proportions of the various species at different seasons are shown in table 28. Whistling Swans, Canada Geese, Black Ducks, American Widgeons, Redheads, and Canvasbacks were predominant. Canada Geese and Black Ducks were numerous throughout the survey periods. American Widgeons were especially common during the fall, whereas the other species were more numerous in winter and early spring.

Canada Geese and Black Ducks prefer the brackish bay areas where fields are nearby, and frequently move back and forth between the open water and the larger grain fields. Whistling Swans, American Widgeons, and various diving ducks are more widely distributed. Many dabbling ducks are common in the brackish estuarine bay marsh. Unusually large numbers of Black Ducks breed along the margins of Eastern Bay and its adjoining estuaries and also in the scattered brackish estuarine bay marshes. The greatest local concentrations of breeding Black Ducks in the entire Upper Chesapeake region are on the islands of Eastern Bay.

## CHOPTANK RIVER SECTION

### Habitats

Habitats in the Choptank River section include large brackish and moderately saline estuarine bays, an extensive estuarine river marsh, and numerous adjoining grain fields. There are extensive beds of submerged aquatic plants and an abundant invertebrate fauna throughout the estuarine bays.

The open estuarine bays are the preponderant habitats in this section. The mouth of the Choptank River (below Blackwalnut Point on Talbot County side and Cook Point on Dorchester County side) and the lower half of the Little Choptank River (below Casson and Susquehanna Points) are moderately saline estuarine bays. The predominant submerged plants include sago pondweed and the more typical salt-water species. The sector of the Choptank River above this (extending up to Chlora Point on Talbot County side and Horn Point on Dorchester County side, and including Harris Creek, Broad Creek, and the Tred Avon River) and the upper half of the Little Choptank River are typically brackish estuarine bays. Fair beds of eelgrass grow here along with more widely distributed brackish species such as claspingleaf pondweed, widgeongrass, and sago pondweed. The upper estuarine bay of the Choptank River, extending to

Raccoon Creek on the Talbot County side and to Cabin Creek on the Dorchester County side, is only moderately brackish. The principal submerged aquatic plants in this sector include common waterweed, claspingleaf pondweed, sago pondweed, and widgeongrass. Eelgrass is absent.

Above Raccoon Creek and Cabin Creek, estuarine river marshes occur along the upper stretches of the Choptank River and its major tributary, Tuckahoe Creek, extending to the towns of Denton and Queen Anne. Both brackish and fresh estuarine river marshes are present. The brackish marshes extend upstream to a point about 1 mile below the mouth of Tuckahoe Creek and the fresh marshes beyond.

### Waterfowl

The Choptank River section is one of the more important waterfowl areas in the Upper Chesapeake region.

January inventory data, during the years 1955-58 show that the wintering population ranged from 40,000 in 1958 to 195,600 in 1955, averaged 117,100. The population peak comes in mid-winter, although large populations also are present in late fall and early spring.

Proportions of the various species at different seasons are shown in table 29. Canada Geese, Black Ducks, Redheads, and Canvasbacks usually are the more important waterfowl during the fall, winter, and spring. Large numbers of American Widgeons are present during the fall flight. Scaup usually are abundant during the spring and occasionally during the winter. Unusually large numbers of Whistling Swans are present during most years.

Canada Geese and Black Ducks prefer the areas of the bays adjacent to the grain fields. Whistling Swans, American Widgeons, and various species of diving ducks are quite generally distributed over the estuarine bays. Most species of dabbling ducks prefer the estuarine river marshes. Scattered pairs of Black Ducks breed in the estuarine marshes and along the margins of the estuarine bays.

## BLACKWATER-NANTICOKE SECTION

### Habitats

Vast expanses of fresh and brackish estuarine marshes are the outstanding feature of the Blackwater-Nanticoke section. Many of these are adjoined by large tracts of swamp timber, and good-sized agricultural fields occur locally.

Four major types of waterfowl habitat are well represented: the fresh estuarine bay marsh, brackish estuarine bay marsh, brackish estuarine river marsh, and brackish estuarine bay. The largest area of fresh estuarine bay marsh is along the upper portion of

the Blackwater River (see map, fig. 3), and smaller secondary areas are in the vicinity of Savannah Lake and along the upper portions of Ireland Creek. A large contiguous area of brackish estuarine bay marsh is drained by tidal streams that empty into the upper portions of Fishing Bay and the estuarine bay of the Nanticoke River and includes the drainage systems along the lower portions of the Blackwater and Transquaking Rivers and Ireland Creek plus the entire watersheds of Irish Creek, Jacks Creek, and Cow Creek. There are two separate areas of brackish estuarine river marsh in this section. The larger is along the Nanticoke River (see map, fig. 3), extending upstream from Long Point on the Dorchester County side and Collier Creek on the Wicomico County side to the village of River-ton. The smaller area of brackish estuarine river marsh is along the upper portion of the Transquaking River and its tributary, the Chicamacomico River. Brackish estuarine bays include the upper part of Fishing Bay and the upper part of the estuarine bay of the Nanticoke River. Both of these areas differ from other brackish estuarine bays in the Upper Chesapeake region in that they usually are quite turbid from organic stain and silt draining into them from numerous swamps and marshes. Submerged plant growth is greatly inhibited by the turbidity, although various invertebrates are quite common.

## Waterfowl

The Blackwater-Nanticoke section is an important waterfowl area. January inventory data during the years 1955-58 show that the wintering population ranged from a low of 22,400 in 1958 to a high of 234,500 in 1956, and averaged 126,500. Wintering populations vary greatly from year to year. Populations usually are high during mild open winters and much lower during severe cold winters with extensive ice formation. The population peak usually comes in late fall, as it did in the 1958-59 season.

Proportions of the various species at different seasons are shown in table 30. Canada Geese, Mallards, Black Ducks, American Widgeons, and Canvasbacks are most important. Other waterfowl that are abundant locally during certain seasons include Pintails, Green-winged Teal, Redheads, and Lesser Scaup. Large numbers of transient Blue-winged Teal often stop in the area during early fall and late spring. During the hunting season, many species are undoubtedly benefited by the sanctuary provided by the Blackwater National Wildlife Refuge.

The ecological distribution of waterfowl in this section varies considerably from one species to another. Most Canada Geese concentrate in the fresh estuarine bay marshes and range out to forage in nearby agricultural

fields. They frequently feed and roost in shoal-water areas of the brackish estuarine bays. Mallards prefer the fresh estuarine bay marsh and the fresher portions of the brackish estuarine river marsh. Black Ducks are well distributed over all three types of estuarine marsh, although most of them are in the brackish estuarine bay marsh. Fairly large numbers of Black Ducks also breed in the brackish estuarine bay marsh. American Widgeons, Gadwalls, and Shovelers occur regularly in both fresh and brackish estuarine bay marshes, but are comparatively scarce elsewhere. Pintails, Green-winged Teal, and Blue-winged Teal are fairly evenly distributed over all three estuarine marsh types. Local breeding populations of Blue-winged Teal are almost entirely restricted to the brackish estuarine bay marsh. Wood Ducks are common in the fresher portions of the estuarine river marsh, and occasionally there are a few in the fresh estuarine bay marsh. Most diving ducks (including the predominant Canvasbacks, Lesser Scaup, Ruddy Ducks, and Common Goldeneyes) generally are restricted to the brackish estuarine bays. Large flocks frequently travel back and forth between Fishing Bay and the Nanticoke River. Ring-necked Ducks and Common Mergansers seem to prefer the fresh estuarine bay marsh and fresher portions of the brackish estuarine river marsh. Hooded Mergansers are most numerous in the brackish estuarine bay marsh.

## LOWER EASTERN SHORE SECTION

### Habitats

Salt estuarine bays and salt estuarine bay marshes are the principal habitats of the Lower Eastern Shore section. The bays contain luxuriant beds of aquatic plants of typical salt-water species. Salinity gradually increases from north to south. As a result, sago pondweed, which is one of the principal plants in the Tar Bay and Honga River areas, becomes progressively scarcer toward the south. The broad marshes along the estuarine bay shores and on the offshore islands are the only large areas of salt estuarine bay marsh in the entire Upper Chesapeake region. There are two fairly large areas of brackish estuarine bay marsh: the Broad Creek marsh, draining into Ellis Bay in Wicomico County, Maryland; and the Marumsco Creek marsh, draining into Pocomoke Sound in Somerset County, Maryland. Numerous brackish estuarine river marshes border tidal streams that extend into the interior. The largest are along the Wicomico and Pocomoke Rivers. A fairly extensive stretch of fresh estuarine river marsh borders the Wicomico River between Pirates Wharf and Shad Point; another much smaller one extends along the upper portions of Pitts Creek near the Maryland-Virginia boundary.

## Waterfowl

This section is most important to waterfowl during unusually cold winters, when the better waterfowl habitats in other sections gradually become frozen over. Waterfowl are much scarcer when weather is moderate.

January inventory data during the years 1955-58 show that the wintering population ranged from 16,600 in 1958 to 106,800 in 1957, averaged 63,600. The population peak comes during late fall and winter. The very marked yearly fluctuation in wintering populations probably is the result of variations in weather.

Proportions of the various species at different seasons are shown in table 31. Canada Geese, Black Ducks, Pintails, and American Widgeons are predominant during the early fall. These same waterfowl, except for the American Widgeons, also are common during late fall and winter. Large numbers of Redheads, Canvasbacks, Greater and Lesser Scaup, Common Goldeneyes, and Buffleheads also are present in late fall and winter. Black Ducks and various diving ducks are the principal waterfowl during early spring.

The salt-water areas ordinarily do not have the high population densities that are characteristic of other habitats in the section, but they are so extensive that they contain more than three-fourths of the waterfowl. The ecological distribution of waterfowl varies considerably from one species to another. Canada Geese are fairly widespread, feeding and roosting in the salt estuarine bay marshes and adjacent shoal-water areas of the salt estuarine bays. Occasional flocks range inland to feed in some of the larger grain fields. Black Ducks are common in the salt estuarine bay marshes during the fall, winter, and early spring. Scattered pairs also breed in this habitat later in the season. Other dabbling ducks (including Gadwalls, Green-winged Teal, and American Widgeons) are fairly common locally during fall, winter, and spring. They prefer managed areas where artificial impoundments have been formed by construction of gut plugs and dams. Wintering and migrant Black Ducks and Pintails and considerable numbers of Brant concentrate locally on some of the more extensive shoal-water areas of the salt estuarine bays, especially in the vicinity of Smith Island and other offshore islands. Diving ducks are fairly common on the salt estuarine bays. The more numerous and widespread diving species include Canvasbacks, Greater Scaup, Lesser Scaup, Common Goldeneyes, and Buffleheads. Redheads usually are abundant in the Tar Bay and Honga River

areas, where there are extensive beds of sago pondweed.

## COASTAL SECTION

### Habitats

The principal habitats of the Coastal section are the oceanic littoral zone, the coastal bays, and the coastal embayed salt marshes. Other less important habitats are estuarine river marshes and brackish estuarine bay marshes. These are restricted to narrow stretches along some of the tidal streams that extend into the interior. Large agricultural fields adjoin the coastal bays.

### Waterfowl

This section is an important area for waterfowl migrating along the Atlantic coast.

January inventory data, during the years 1955-58 show that the wintering population ranged from 21,400 in 1958 to 62,600 in 1957, averaged 44,000. The yearly variation in numbers of wintering waterfowl is not so great as in other sections of the Upper Chesapeake region. The population peak is in the late fall.

Proportions of the various species at different seasons are shown in table 32. Canada Geese, Brant, Black Ducks, Canvasbacks, and scaup are predominant during winter. These plus Mallards, Pintails, Green-winged Teal, Blue-winged Teal, and American Widgeons are numerous during migration.

Sea ducks, particularly the three species of scoters, are the more characteristic waterfowl on the ocean; they are largely restricted to the littoral zone within 1 mile of the beach. Brant, Red-breasted Mergansers, and various diving ducks (including Greater Scaup, Common Goldeneyes, Buffleheads, and Oldsquaws) are the more numerous waterfowl of the coastal bays. Black Ducks are the only common and widely distributed waterfowl in the coastal embayed salt marshes. Black Ducks and Canada Geese frequently travel back and forth between the coastal embayed marshes, shoal-water areas of the coastal bays, and nearby agricultural fields of the mainland. Pintails, American Widgeons, and other dabbling ducks are common in areas where artificial impoundments have been made by constructing dams, gut plugs, and dikes. Several thousand Canvasbacks often roost on Heines Pond, near the western shore of Newport Bay.



## SPECIES ACCOUNTS

Detailed accounts for each species of waterfowl occurring in the Upper Chesapeake region are presented in the following pages.

Accounts of the different species vary greatly in the amount of information they contain, for all species were not studied with equal intensity. Discussions are organized as follows: introduction (size of the Chesapeake population and its proportion in the Atlantic and continental population, breeding and migration dates), habitats, biogeographic sections, food habits, local distribution of hunting kill, and harvest areas of birds banded in the Upper Chesapeake region. Methods of presenting food-habits and band-recovery data are discussed in the introduction.

### WHISTLING SWAN

*Olor columbianus* (Ord)

Large numbers of Whistling Swans migrate through, and winter in, the Upper Chesapeake region. January inventories for the years 1953-58 show that the wintering population ranged from 17,000 in 1958 to 71,600 in 1955, averaged approximately 39,100. This average figure represents about 44% of the continental population and 77% of the Atlantic population. The fall migration usually is during the period from October 15-25 to November 20-30, with the peak between October 25 and November 20. The normal spring migration extends from March 1-10 to April 20-30, with the peak between March 10 and April 5. Whistling Swans normally are in flocks of 5 to 200 or more individuals.

A detailed report concerning the local distribution, numerical status, habitat, and food habits of Whistling Swans in the Upper Chesapeake region has been published (Stewart and Manning, 1958). The present report contains additional information.

#### Habitats

Whistling Swans generally are restricted to fairly extensive areas of open estuarine waters no more than 5 feet deep. The larger concentrations are in places where submerged plants are abundant. Swans ordinarily do not inhabit the salt estuarine bays except locally. Small numbers may occur in the Tar Bay and Honga River areas and in the vicinity of Bloodworth and South Marsh Islands. Small numbers also occur on some of the larger ponds of the fresh and brackish estuarine bay marshes in Dorchester County. The greatest wintering concentrations of swans normally occur in the brackish estuarine bays. Relatively small numbers occur in the fresh and

slightly brackish estuarine bays, which are subject to frequent freezing.

January inventories of 1955-58 showed the average ecological distribution of wintering populations as follows: brackish estuarine bays - 76%; salt estuarine bays - 9%; fresh estuarine bays - 8%; slightly brackish estuarine bays - 6%; coastal impoundment-bay complex - 1%; and fresh and brackish estuarine bay marshes - +%.

During the spring and fall migration periods, Whistling Swans occur regularly in fairly large numbers throughout open shallow tide-water areas of fresh and slightly brackish estuarine bays. Scattered individuals or small flocks occasionally are found for brief periods on some of the larger reservoirs and impoundments of the coastal plain interior.

Seasonal distribution during the 1958-59 season is shown in table 33. The majority of the swans inhabited brackish estuarine bays during late fall, winter, and early spring. A large proportion of the earlier arrivals during the fall migration occupied the fresh estuarine bays.

#### Biogeographic Sections

The average distribution of Whistling Swans during the January inventories of 1955-58 is shown in table 34.

Sixty-three percent of the average wintering population was along the central portions of the eastern shore of Chesapeake Bay in the Chester River, Choptank River, and Eastern Bay sections. Most of the remaining birds (34% of the total) were distributed over the Central Western Shore, Lower Eastern Shore, Upper Western Shore, Susquehanna Flats, Lower Potomac, and Central Potomac sections.

Population surveys during the fall, winter, and early spring of the 1958-59 season showed seasonal changes in numbers of birds (table 35). The greatest populations of migrant and wintering swans were along the central eastern shore in the Choptank River, Eastern Bay, and Chester River sections. Large numbers used the Susquehanna Flats, particularly during spring migration. Areas of greatest local concentrations included the lower Choptank River (especially along the north shore), the central Chester River, and upper Eastern Bay. Fairly large numbers also were found in the lower Chester River, central Choptank River, Miles River, Central Western Shore, Upper Western Shore, and Central Potomac areas.

#### Food Habits

The gullet and gizzard food contents of 50 swans were examined (table 36).

Leaves, stems, and roots of submerged plants appear to be the foods of paramount importance to Whistling Swans in all areas where the birds occur in greatest concentrations. Wild celery apparently is the principal food in fresh estuarine bays, whereas widgeongrass and sago pondweed are utilized to the greatest extent in the critical brackish estuarine bay communities. Certain species of thin-shelled bivalve mollusks, particularly the Baltic macoma (*Macoma balthica*) and the commercially valuable long or "soft-shelled" clam (*Mya arenaria*) are also consumed in considerable quantities in the brackish estuarine bays. The small population of swans on the estuarine bay marsh ponds of Dorchester County shows their adaptability by consuming not only widgeongrass but other entirely different types of foods, including rootstalks and stems of certain emergent marsh plants.

## CANADA GOOSE

*Branta canadensis* (Linnaeus)

Canada Geese are common, locally abundant, transients during spring and fall in most of the Upper Chesapeake region. Large numbers remain throughout the winter in certain areas, particularly on the Eastern Shore. January inventories for 1953-58 show that the wintering population ranged from 95,400 in 1958 to 269,100 in 1955, averaged approximately 189,600. This average figure represents about 18% of the continental population (excluding the Cackling Goose) and about 45% of the Atlantic population. The fall migration usually is during the period of September 25 - October 5 to November 20-30, with the peak between October 15 and November 5. The normal spring migration extends from February 15-25 to April 15-25, with the peak between March 10 and April 10.

### Habitats

Extensive agricultural areas adjacent to open, shallow expanses of fresh, slightly brackish, or brackish estuarine bays apparently are the optimum habitat of Canada Geese in the Upper Chesapeake region. These habitat conditions are widespread along the eastern shore in the area extending from the Bohemia River to the Choptank River. Approximately 70% of the average wintering population in the Upper Chesapeake region during 1955-58 was in this area. The geese ordinarily fed in the larger grain fields and both fed and roosted on the shallow estuarine waters. Large numbers of geese also roosted locally on the fresh-water impoundments that are scattered through the farmlands.

Fairly large numbers of Canada Geese also were found throughout the extensive estuarine

bay marshes below the Choptank River and in the coastal salt marshes. In the winters of 1955-58, approximately 16% of the Upper Chesapeake population occurred in the fresh and brackish estuarine bay marshes of the Blackwater-Nanticoke section; about 9% occurred in the salt estuarine bay marshes of the Lower Eastern Shore section; and about 3% in or near the salt marshes of the Coastal section. The geese fed in both fields and marshes. In the marshes they usually fed in associations of common three-square, Olney three-square, or saltmarsh cordgrass, or in shallow ponds containing submerged plants. They roosted on the larger marsh ponds or impoundments as well as on adjacent estuaries or coastal bays.

Habitats suitable for Canada Geese are rather limited in the various western shore, Patuxent River, and Potomac sections. Most of the agricultural fields in these sections are small and somewhat scattered, and the shallow zones of the adjacent estuaries usually are quite narrow. Most of the marshes are small isolated patches. The greatest concentration of geese in the areas is in the vicinity of St. Marys River in St. Marys County.

### Biogeographic Sections

The average distribution of Canada Geese during the January inventories of 1955-58 is shown in table 37. Approximately 95% of the population occurred in the sections along the eastern shore of Chesapeake Bay, about 3% were in the Coastal section, and only 2% in the various western-shore sections (including the Susquehanna Flats and Potomac River sections). Greatest concentrations (about one-fourth of the total) were in the Chester River section.

Seasonal changes in numbers during 1958-59 are shown in table 38. The Chester River and Upper Eastern Shore sections had relatively high populations during all five surveys. The Eastern Bay and Choptank River sections had large numbers of geese during November, December, January, and March, but relatively small numbers during October. Comparatively large numbers were in the Blackwater-Nanticoke section during October and November. Greatest local concentrations were in the central Chester River, Sassafras River, and lower Choptank River (chiefly north shore) areas.

### Food Habits

The gullet and gizzard food contents of 15 Canada Geese were examined (table 39). Numerous field observations, plus the limited data from analyses, indicate that waste corn in the fields is the food of primary importance for Canada Geese in areas where extensive

agricultural fields adjoin shallow estuarine bays. Young sprout growth of wheat, rye, and barley, and the leaves, stems and rootstalks of various submerged plants are consumed in considerable quantities. Geese occasionally feed extensively in hayfields, pastures, and soybean fields.

Rootstalks and stems of certain emergent marsh plants probably are most important in the large estuarine bay marshes and coastal salt marshes. Rootstalks and stems of common three-square and Olney three-square are taken in large quantities in the fresh and brackish estuarine bay marshes. Saltmarsh cordgrass and saltgrass are eaten more commonly in the salt estuarine bay marshes and coastal embayed marshes. Other important foods include the leaves, stems, and rootstalks of submerged plants (especially widgeongrass) and the seeds of common three-square, twig-rush, and other emergent plants. Corn and sprout growth of wheat and rye are taken in fair amounts in certain areas where fields are nearby.

### Local Distribution of Hunting Kill

Information concerning the local distribution of the hunting kill of Canada Geese within the Upper Chesapeake region (excluding the Coastal section) was obtained through an analysis of the distribution of 133 weighted recoveries of birds banded outside Maryland and Virginia (table 40). These recoveries were reported during the years 1951-58. The number per year ranged from 8 in 1951 and 1954 to 39 in 1956. Data from the Coastal section were excluded because the breeding-ground origin and migration routes of birds in the Coastal section differ somewhat from birds in Chesapeake Bay proper (based on unpublished data in the Bureau's banding office).

About 83% of the total kill occurred in the Chester River, Choptank River, Lower Eastern Shore, and Upper Eastern Shore sections. Approximately 72% of the kill occurred in the estuarine bay - agricultural field complex that extends from the Bohemia River to the Choptank River; about 23% of the kill occurred in the estuarine bay marsh complex below the Choptank River; and nearly 5% along the Potomac River estuary. A more detailed analysis showed that the kill was heavily concentrated in a few local areas: central Chester River area - 20% of total; Sassafras River - 10%; central Choptank River - 10%; north shore of lower Choptank River - 8%; and lower Tangier Sound - 7%. The kill of Canada Geese as related to their local populations was proportionally high in the Lower Eastern Shore section and proportionally low in the Blackwater-Nanticoke section. Kill data arranged by months showed that 53% of the kill was in November, 31% in December, and 16% in January.

### Harvest Areas of Birds Banded in the Upper Chesapeake Region

Data concerning harvest areas of Canada Geese banded at the Blackwater National Wildlife Refuge during the years 1951-58 came from 105 indirect band recoveries reported to the Bureau's banding office (table 41). About half of the recoveries from birds banded in fall and roughly two-thirds of those from birds banded in winter and spring were from the mid-Atlantic States. More than one-third of the recoveries from birds banded in fall and winter and about half of those from birds banded in spring were from Maryland. The only other important harvest area was the province of Quebec and adjoining parts of east-central Canada, where nearly half of the recoveries from fall-banded birds were taken. Less than one-fifth of the recoveries from winter- and spring-banded birds were taken in this area. These differences may indicate that Canada Geese present in the Upper Chesapeake region in fall come from different breeding grounds and have different migration routes from those present in winter and spring.

The magnitude of the kill of Canada Geese in Maryland is shown by the kill in Kent County, where about 35,000 birds were shot during the 1956 season (Linduska, 1958). Most of these birds, however, were taken with the aid of recording machines, whose use for this purpose has since been declared illegal. The kill of Canada Geese in Kent County has been appreciably lower since then.

### BRANT

*Branta bernicla* (Linnaeus)

Brant are common spring and fall transients and winter residents on the coastal bays during most years. Fairly large numbers occasionally occur along the eastern shore of Chesapeake Bay in the area from Pocomoke Sound to the Honga River. A few flocks sometimes are present farther up between the Honga River and the lower portion of Eastern Bay.

Numbers vary greatly from year to year. January inventories for 1953-58 show that the wintering population ranged from 100 in 1955 to 32,200 in 1954, averaged 9,300. This average figure represents about 5% of the continental wintering population, which is restricted almost entirely to the Atlantic coastal area from Massachusetts to North Carolina. Approximately 99% of the average wintering population of the Upper Chesapeake region during 1955-58 was in the Coastal section; less than one-half of one percent was in the Lower Eastern Shore section and the Choptank River section. The fall migration ordinarily takes place during the period of October 10-20 to December 10-20, with the peak between

October 25 and December 10. The normal spring migration extends from February 10-20 to April 20-30, with the peak between February 20 and April 10.

## Habitats

Brant are especially characteristic of the shallow expanses of salt water of the coastal bays. They ordinarily are most numerous along the barrier-beach side of the bays, and tend to concentrate wherever sea-lettuce is abundant. Along the eastern shore of Chesapeake Bay, the greatest numbers occur in the shallow salt waters of Tangier Sound and adjoining estuaries, particularly in areas where eelgrass and widgeongrass are common. Brant occasionally occur in shallow areas of brackish waters near the mouth of the Choptank River and lower part of Eastern Bay.

## Biogeographic Sections

Seasonal changes in the Upper Chesapeake populations during 1958-59 are shown in table 42. The Coastal section was the only important area for this species after the majority of the birds arrived. Within the Coastal section, most of the birds usually concentrated in the Sinepuxent Bay area.

## Food Habits

The gullet and gizzard food contents of 13 Brant were examined (table 43). Brant apparently feed almost entirely on sea-lettuce along the coast; eelgrass and widgeongrass probably are more important in Chesapeake Bay. Before 1931, when eelgrass also was abundant along the Atlantic coast, the coastal birds fed on it almost exclusively (Cottam, Lynch, and Nelson, 1944).

## Local Distribution of Hunting Kill

Information concerning local distribution of hunting kill of Brant within the Upper Chesapeake region was obtained through an analysis of the distribution of 42 weighted recoveries of birds banded outside of Maryland and Virginia. Ten of the recoveries were reported in 1956 and 32 in 1957. Forty-two percent were from the Coastal section, 41% from the Lower Eastern Shore section, 12% from the Choptank River section, and 5% from the Eastern Bay section. The comparatively high proportion of the kill along the eastern shore of Chesapeake Bay suggests that the Brant populations may have been appreciably larger in this area during 1956 or 1957 than they were during 1958-59. The greatest local kill (26% of the total) was in the lower end of Chincoteague

Bay (Virginia portion). Kill data arranged by months showed that 42% of the kill was in November, 35% in December, and 23% in January.

## SNOW GOOSE

### *Chen hyperborea* (Pallas)

Geese of the larger race of this species, *Chen hyperborea atlantica* Kennard, often called the Greater Snow Goose, occur regularly along the coast during migration, and occasionally are fairly numerous. A few small flocks usually winter in this area. Along the eastern shore of Chesapeake Bay, in the area between the Sassafras River and Fishing Bay, there are a few scattered Snow Geese, which often are associated with Blue Geese. Probably these few birds are of the smaller race, *Chen hyperborea hyperborea* (Pallas), often referred to as the Lesser Snow Goose.

The January inventories for 1953-58 show that the wintering population ranged from zero in 1953 and 1955 to 4,200 in 1956, averaged 1,400. This average figure is only a very small fraction of the continental population (747,000) and about 3% of the Atlantic population.

The fall migration of Snow Geese usually is during the period of October 15-25 to December 15-25, with the peak between November 20 and December 10. The normal spring migration extends from February 10-20 to March 20-30, with the peak between February 20 and March 10.

## Habitats

Marshes of saltmarsh cordgrass, fringing the coastal bays or occurring as islands within them, are the principal habitat of Snow Geese.

## Biogeographic Sections

Approximately 99% of the average wintering populations during 1955-58 were in the Coastal section. Less than one-half of one percent was in the Chester River, Choptank River, and Blackwater-Nanticoke sections. The larger local concentrations usually are found along the barrier-beach side of Chincoteague Bay.

## Food Habits

Field observations indicate that Snow Geese feed to a large extent on the rootstalks of saltmarsh cordgrass.

## BLUE GOOSE

*Chen caerulescens* (Linnaeus)

Small flocks or scattered birds occasionally occur along the eastern shore of Chesapeake Bay. There are a few records of their presence in the western shore areas and along the coast. These small groups or individuals usually are associated with small numbers of Snow Geese. Dates of records of Blue Geese in the Upper Chesapeake region extend from mid-October to mid-May.

### Habitats

These geese have been observed in open estuarine waters, in artificial impoundments, and in agricultural fields nearby. A few occasionally are seen in the large estuarine bay marshes of Dorchester and Somerset Counties, and in the coastal salt marshes of Worcester County.

### Food Habits

The gullet and gizzard food contents of one Blue Goose were composed entirely of leaf fragments of saltmarsh cordgrass. The bird was collected in the brackish estuarine bay marshes of Dorchester County on November 25, 1955.

## MALLARD

*Anas platyrhynchos* Linnaeus

The mallard is a locally common transient during spring and fall, and a winter resident, throughout most of the Upper Chesapeake region. A few scattered pairs of birds breed in the region during the summer months. The breeding birds probably are derived from introduced game-farm stock. January inventories for 1953-58 show that the wintering population ranged from 16,300 in 1953 to 150,900 in 1956, averaged approximately 68,700. This average figure represents less than 1% of the continental population and about 24% of the Atlantic population. The fall migration usually is during the period of September 10-20 to December 15-25, with the peak between October 25 and December 5. The normal spring migration extends from February 5-15 to May 1-10, with the peak between February 20 and March 20.

### Habitats

Shallow brackish estuarine bays with adjacent extensive agricultural areas apparently are the optimum combination of habitats for

Mallards in the Upper Chesapeake region. These conditions are widespread in the Chester River section, where the greatest numbers of birds occur. Large numbers also are present in the complex of brackish estuarine bays and agricultural fields of the Eastern Bay and Choptank River sections. Mallards also are numerous in the complex of fresh estuarine bays and agricultural fields of the Upper Eastern Shore section. Mallards in these areas feed chiefly in the larger grain fields. They roost in the shallow open estuarine waters and also feed there to a limited extent. Many Mallards roost on the artificial ponds that are scattered through the farmlands.

Mallards usually are locally common in the scattered estuarine river marshes throughout the region, and in the fresh estuarine bay marshes of the Blackwater-Nanticoke section. Fair numbers occasionally are present in the brackish estuarine bay marshes in the Blackwater-Nanticoke section and in the various river swamps, flood-plain forests, and draw-down marsh impoundments that are scattered throughout the coastal plain interior. Relatively small numbers are ordinarily present in the coastal salt marshes or in the salt estuarine bay marshes of the Lower Eastern Shore section. The birds generally feed and roost in these habitats, although locally they may feed in adjacent grain fields. When Mallards are unduly disturbed by excessive hunting or other human activities, they sometimes shift to some of the larger estuarine bays nearby.

The ecological distribution of Mallard populations during the 1958-59 season is shown in table 44. From 50% to 86% of the total population was found in the complex of shallow estuarine bays and agricultural fields in the Chester River, Upper Eastern Shore, Eastern Bay, and Choptank River sections. Fairly large numbers also were counted in the estuarine river marshes that are scattered through the region, and in the fresh estuarine bay marshes of the Blackwater-Nanticoke section.

Two nests were found of Mallards believed to be wild birds. One nest, containing 12 eggs, was found on April 22, 1944, at the Patuxent Wildlife Research Center; the nest was on a small brushy hummock about 50 feet from shore in one of the larger impoundments. The other nest, also containing 12 eggs, was found June 26, 1957, on one of the small islands in Sinepuxent Bay; it was in a patch of saltmeadow cordgrass under a groundselbush.

### Biogeographic Sections

The average distribution of Mallards during the January inventories of 1955-58 is shown in table 45. The Blackwater-Nanticoke and Chester River sections contained about two-thirds of the total Upper Chesapeake population. Fair

populations also were present in the Eastern Bay, Choptank River, and Upper Eastern Shore sections.

Seasonal changes in numbers are shown in table 46. During all five surveys, the Chester River section contained much higher populations than any of the other areas. Fairly large numbers were in the Blackwater-Nanticoke section, and, during some of the surveys, considerable numbers were in the Eastern Bay, Upper Eastern Shore, Choptank River, Patuxent River, and Coastal sections. The central Chester River was the outstanding local concentration area for Mallards in the Upper Chesapeake region. Other important concentration areas were in the upper Blackwater River area, the upper Chester River, upper Eastern Bay, Kent County bay shore, and the Patuxent River marsh.

### Food Habits

The gullet and gizzard food contents of 85 wild Mallards were examined (tables 47-51). A single bird not referred to in the tables was collected in the coastal marshes at Newport Bay during March.

Seeds and leaves of widgeongrass and claspingleaf pondweed, and corn were the more important foods in the complex of estuarine bays and agricultural fields (table 47). In the river marshes, the more important foods included the seeds of dotted smartweed, softstem bulrush, common three-square, halberdleaf tearthumb, and arrow-arum (table 48). Principal foods in the estuarine bay marshes were seeds, leaves, stems, and rootstalks of widgeongrass; seeds of Olney three-square and twigrush; and corn (chiefly bait) (table 49). Principal foods in the river bottomland were beech and white-oak mast, seeds of hornbeam, and vegetative parts of the alga nitella (table 50). Principal foods in the draw-down marsh impoundments were seeds of common burreed; other foods taken in fairly large quantities in this habitat included the seeds of weakbulrush, buttonbush, sedge (*Carex lurida*), dotted smartweed, and rice cutgrass (table 51). The single bird collected in the coastal marshes had fed chiefly on the seeds of Olney three-square and common three-square.

### Local Distribution of Hunting Kill

Information concerning local distribution of the hunting kill of Mallards within the Upper Chesapeake region was obtained through an analysis of the distribution of 244 weighted recoveries of wild birds banded outside of Maryland and Virginia (table 52). These recoveries were reported during the years 1953-57. The number per year ranged from 31 in 1953 to 80 in 1957.

Nearly 25% of the kill occurred in the Chester River section alone. Approximately 53% of the kill occurred in the area from the Bohemia River to the Choptank River; shallow estuarine bays with adjoining agricultural fields are common in this area. Eighteen percent of the kill was distributed over the Blackwater-Nanticoke and Lower Eastern Shore sections, areas that contain extensive estuarine bay marshes. Approximately 13% of the total kill was reported from the salt marshes and adjacent impoundments in the Coastal section, and 14% of the kill came from the various areas west of Chesapeake Bay (including the Susquehanna Flats, Patuxent, and Potomac River sections). Two percent of the kill occurred in the coastal plain interior, away from tidewater. The central and lower portions of the Chester River were the only local areas in which the kill was heavily concentrated (22% of total). The kill of Mallards as related to their local populations was proportionally low in the Blackwater-Nanticoke section. Kill data arranged by months showed that 24% of the kill was in November, 52% in December, and 24% in January.

### Harvest Areas of Birds Banded in Upper Chesapeake Region

Data concerning harvest areas of wild Mallards banded in the Dorchester County marshes and in the Chester River-Eastern Bay area during the years 1950-58 came from 170 indirect recoveries (table 53). About half of the kill of birds banded in fall and winter, and two-fifths of the kill of those banded in spring were shot in the mid-Atlantic States. A third of the recoveries of fall-banded birds, and a fourth of the recoveries of winter- and spring-banded birds were from Maryland alone. Most of the other recoveries were fairly evenly distributed over the eastern Great Lakes area, the north-central States, east-central Canada, and the Prairie Provinces of Canada.

### BLACK DUCK

*Anas rubripes* Brewster

Black Ducks are the only waterfowl that are widely distributed over the Upper Chesapeake region throughout the year. They occur regularly as summer residents, winter residents, and spring and fall transients.

January inventories for 1953-58 show that the wintering population ranged from 49,500 in 1958 to 229,500 in 1955, averaged 129,700. This average figure represents about 19% of the continental wintering population and 28% of the Atlantic population. The pre-eminence of the wintering populations in Maryland, as compared with those of other States, is shown

by census data listed by Stewart (1958).

The breeding season generally extends from mid-March to early September, with the peak between early April and late June. Extreme egg dates (217 nests) range from March 9 (V. D. Stotts) to August 24; extreme dates for downy young (54 broods) range from April 8 to late September (V. D. Stotts). Comparative sexual development and pairing throughout the year are described by Stotts (1958b).

Fall migration usually is during the period of September 10-20 to December 1-10, with the peak between October 20 and November 25. The normal spring migration extends from February 15-25 to April 15-25, with the peak between February 25 and March 25.

## Habitats

Black Ducks are characteristic of a greater variety of habitats within the Upper Chesapeake region than any other waterfowl.

During migration and wintering periods, they occupy habitats ranging from the bottomlands and freshwater impoundments of the coastal plain interior to the coastal salt marshes, including estuarine river marshes as well as fresh, brackish, and salt estuarine bay marshes. They also are common in the complex of estuarine bays and agricultural fields. Ecological distribution during the 1958-59 season is shown in table 54. From one-half to two-thirds of the population occupied the shallow estuarine bays and adjoining agricultural fields of the Chester River, Eastern Bay, Choptank River, and Upper Eastern Shore sections. They were more common in the moderately brackish estuaries of the Chester River, in the typical brackish estuaries of the Eastern Bay and Choptank River sections, and in the fresh and slightly brackish estuaries of the Upper Eastern Shore section than they were in other areas. Fairly large numbers were present in the estuarine bay marshes of the Blackwater-Nanticoke and Lower Eastern Shore sections, and in the coastal salt marshes. During late fall, winter, and early spring of the 1958-59 season, they seemed to prefer the coastal salt marshes and salt estuarine bay marshes to the estuarine fresh and brackish bay marshes. Many were present in the estuarine river marshes during the fall migration (October, November) and during the spring migration (March).

The largest breeding populations are along the margins of shallow brackish open estuaries of the Chester River, Eastern Bay, and Choptank River sections and in the extensive brackish estuarine bay marsh of the Blackwater-Nanticoke section. Fairly large breeding populations also are present in the salt estuarine bay marshes of the Lower Eastern Shore section. Scattered pairs inhabit the coastal salt marshes, the fresh estuarine

bay marsh, and the various areas of estuarine river marsh. A few pairs have become established locally in the vicinity of freshwater impoundments or along river bottomlands of the coastal plain interior. Concentrations of breeding Black Ducks occur on some of the islands and isolated points of land in the shallow estuarine waters of the Chester River, Eastern Bay, and Choptank River sections. In 1953, Stotts (1956) found 79 breeding pairs on Parson and Bodkin Islands (located in Eastern Bay). This was a density of about 58.5 pairs per 100 acres of island since the two islands together contained 135 acres. However, since the shallow estuarine waters surrounding the islands were used extensively for feeding, the true density, considering all habitats that were utilized, was much lower. In 1956, I found 53 pairs (5.3 pairs per 100 acres) of Black Ducks in a census of 1,000 acres of brackish estuarine bay marsh in Dorchester County within the Blackwater-Nanticoke Section.

Black Ducks construct their nests in a variety of situations. In the brackish estuarine bay marshes of the Blackwater-Nanticoke section, 7 nests were found in big-cordgrass border along tidal creeks; 2 in saltmeadow cordgrass association; 2 in Olney three-square--saltmeadow cordgrass association; 2 in saltmarsh cordgrass--hightide-bush association; 1 in needlerush association; 1 in switchgrass association; and 1 in the brushy margin of an island. Fourteen nests were found in other habitats: coastal embayed marshes, salt estuarine bay marshes, and interior areas. Nest sites were similar to those in the brackish marshes. Black Ducks nesting along the margins of estuarine bays in the Chester River, Eastern Bay, and Choptank River sections often build their nests in marginal thickets, including tangles of Japanese honeysuckle.

Biologists of the Maryland Game and Inland Fish Commission found a total of 356 nests on three small islands in the Kent Island area during the 1953 and 1954 breeding seasons (Stotts, 1955). About 80% of the nests were in wooded areas, near the margins; next greatest numbers were in marshes and cultivated fields. Stotts (1958a) found that Black Ducks often use offshore hunting blinds as nesting sites. In a survey of the Upper Chesapeake area during 1957-58, he found that 106 offshore blinds, 10% of the 1,009 that were inspected, were used by nesting ducks (chiefly Black Ducks). Ducks apparently preferred blinds covered or "brushed" with cedar and situated in waters lying adjacent to cultivated land, buildings, or high eroding banks.

## Biogeographic Sections

The average distribution of wintering populations during 1955-58 is shown in table 55.

Approximately 85% of the Black Ducks were in the sections along the eastern shore of Chesapeake Bay; 8% were in the sections west of the Bay, including Susquehanna Flats, Patuxent River and Potomac River sections; and 7% were in the Coastal section. Nearly one-third of the wintering population was in the Chester River section alone. Other large populations (39% of the total) were in the Eastern Bay, Choptank River, and Blackwater-Nanticoke sections.

Seasonal changes in numbers during 1958-59 are shown in table 56. The Chester River section was the outstanding Black Duck area in the region. The Coastal, Choptank River, Eastern Bay, Lower Eastern Shore, and Blackwater-Nanticoke sections also had large numbers of Black Ducks during all five surveys. The Upper Eastern Shore section contained fairly large populations during fall and spring, but only relatively small numbers in winter. The central Chester River was the most important local concentration area. Other local concentration areas included the lower Chester River, outer Chincoteague Bay, upper Eastern Bay, and the Hooper Island-Elliott area of the Lower Eastern Shore section.

During the warmer months, breeding Black Ducks are common in the Chester River, Eastern Bay, and Blackwater-Nanticoke sections. They are fairly common in the Choptank River and Lower Eastern Shore sections; uncommon in the Upper Eastern Shore, Susquehanna Flats, Upper Western Shore, Central Western Shore, and Coastal sections; rare in the Lower Western Shore and Patuxent River sections and in the Upper, Central, and Lower Potomac River sections. A very few breed locally in the coastal plain interior.

## Food Habits

The gullet and gizzard food contents of 212 adult (or fully fledged immature) Black Ducks were examined (tables 57-63). In addition to the records shown in the tables, food contents were analyzed for four Black Ducks shot at impoundments in Kent County in November and December; and three shot at impoundments at Patuxent Wildlife Research Center during October, November, and March. The predominant foods in the complex of brackish estuarine bays and agricultural fields of the Chester River, Eastern Bay, and Choptank River sections were (table 57): claspingleaf pondweed (seeds, leaves, stems, and rootstalks), widgeongrass (seeds, leaves, stems, and rootstalks), eelgrass (stems and leaves), corn (taken chiefly from grain fields), and the bivalve mollusk Baltic macoma (*Macoma balthica*). In the fresh estuarine bay marshes in the Blackwater-Nanticoke section, the more important foods included (table 58): twigrush (seeds), Olney three-square (seeds), and fish. In the brackish estuarine bay marshes of the

Blackwater-Nanticoke section, the more important foods were (table 59): Olney three-square (seeds), widgeongrass (seeds, rootstalks and leaves), saltmarsh snails (*Melampus bidentatus*), and fish (chiefly Poeciliidae). In the salt estuarine bay marshes, the more important foods were (table 60): fish (chiefly Poeciliidae), and the seeds, stems, leaves, and rootstalks of widgeongrass. The few birds from the coastal salt marshes (table 61) had fed chiefly on saltmarsh snails (*Melampus bidentatus*), ribbed mussels (*Velosella demissa*), and the seeds of widgeongrass. In estuarine river marshes (table 62), seeds of dotted smartweed were taken in greatest quantity; other foods taken in considerable amounts included: the seeds of halberdleaf tearthumb, pickerelweed, arrowleaf tearthumb, wildrice, common burreed, giant burreed, and arrow-arum. In the wooded bottomlands along the Patuxent River (table 63), the principal foods were beechnuts and oak acorns; seeds of hornbeam and other woody and herbaceous plants; and the gastropod *Ambloxis decusum*, and other species of small mollusks. In the interior impoundment areas of Kent County, corn was the predominant food. On the impoundments at the Patuxent Wildlife Research Center, the more important foods were seeds of a variety of herbaceous plants. The principal species were: dotted smartweed, arrowleaf tearthumb, largeseed smartweed, common burreed, rice cutgrass, warty panicum, weak bulrush, and cyperus (*C. strigosus* and *C. erythrorhizos*).

Data concerning seasonal changes in food habits were obtained from the Black Ducks shot in brackish estuarine bay marshes of the Blackwater-Nanticoke section (table 59). The principal foods (those occurring in more than 20% of the birds) each month were: September, widgeongrass (leaves, stems and rootstalks) and saltmarsh snails (*Melampus bidentatus*); October, high-tide bush (seeds), Olney three-square (seeds), widgeongrass (seeds), saltmarsh bulrush (seeds), and saltmarsh snails; November, widgeongrass (seeds, leaves, stems and rootstalks), Olney three-square (seeds), and twigrush (seeds); December and January, widgeongrass (seeds, leaves, stems and rootstalks), Olney three-square (seeds), and fish (chiefly Poeciliidae); March, saltmarsh snails; and June, mosquitoes (Culicidae, larvae and pupae), saltgrass (leaves, stems and rootstalks), adult beetles (Coleoptera), and saltmarsh bulrush (seeds).

Food contents of three juvenal Black Ducks were examined. All were collected on June 11, 1954, in salt estuarine bay marshes of Somerset County in the vicinity of Dames Quarter. Two from one brood (less than one-fourth grown) had fed entirely on seeds of widgeongrass. The other (about one-third grown) contained more than 60 saltmarsh snails (*Melampus bidentatus*) and numerous seeds and fruiting stalks of widgeongrass.



## Local Distribution of Hunting Kill

Information concerning the local distribution of the hunting kill of Black Ducks within the Upper Chesapeake region (excluding the Coastal section) was obtained through an analysis of the distribution of 741 weighted recoveries of birds banded outside of Maryland and Virginia (table 64). These recoveries were reported during the years 1948-58. The number per year ranged from 29 in 1952 to 123 in 1955. Data from the Coastal section were excluded because the breeding-ground origin and migration routes of birds in the Coastal section apparently differ somewhat from those of birds in the Chesapeake Bay proper. Addy (1953) suggested, on the basis of available banding data, that Chesapeake Bay may be of major importance to Black Ducks from Ontario and western New York and that the coastal area may be used to a greater extent by birds from the northeastern maritime areas.

Approximately 57% of the total kill of Black Ducks occurred in the area that extends from the Bohemia River to the Choptank River, where a large proportion of the habitat consists of shallow estuarine bays adjoined by agricultural fields. About 23% of the kill was distributed over the Lower Eastern Shore and Blackwater-Nanticoke sections, areas that contain extensive estuarine bay marshes. Roughly 10% was in the western shore areas below the Patapsco River (including Potomac and Patuxent River sections), and 8% in the fresh-water areas of the Upper Western Shore and Susquehanna Flats sections. Only 1% of the total kill was in the coastal plain interior. Greatest local concentrations of kill were in the upper Eastern Bay area (11%), central and lower Chester River (10%), St. Michaels area (6%), and central Choptank area, near Cambridge (5%). The kill of Black Ducks as related to their local populations was proportionally low in the Chester River section.

Information concerning the kill within the Coastal section (not shown in the table) was based on 140 weighted recoveries of birds banded outside of Maryland and Virginia. These recoveries were reported from the Coastal section during the years 1949-58. The number per year ranged from 6 in 1954 to 23 in 1955. The distribution of the kill was: northern Chincoteague-Sinepuxent Bay area, 36%; southern Chincoteague Bay area, 27%; central Chincoteague Bay area, 22%; and Assawoman-Isle of Wight Bay area, 15%.

Kill data arranged by months for all areas, including the Coastal section, showed that 31% of the kill was in November, 44% in December, and 25% in January.

## Harvest Areas of Birds Banded in Upper Chesapeake Region

Data concerning harvest areas of Black Ducks banded in the Chester River-Eastern

Bay area and in the Dorchester County marshes during the years 1950-58 came from 421 indirect band recoveries (table 65). The great majority of the birds were taken in the mid-Atlantic States, the proportions ranging from 74% for spring-banded birds to 92% for summer-banded birds. About three-fifths of the recoveries from birds banded in winter and spring and about three-fourths of those from birds banded in summer and early fall were reported from Maryland alone. Other harvest areas of some importance, particularly for birds banded in winter and spring, were east-central Canada (Quebec, Ontario) and the north Atlantic States.

Stotts (1957) analyzed both direct and indirect recoveries of Black Ducks banded in Maryland and concluded that most of the harvest of birds banded in Maryland also was in Maryland, and within 25 miles of the banding stations.

## GADWALL

*Anas strepera* Linnaeus

Transient and wintering Gadwalls usually are fairly numerous in the central portions of the Potomac River estuary. A few also are scattered through the extensive marshes of the Blackwater-Nanticoke, Lower Eastern Shore, and Coastal sections. Gadwalls are rare and irregular elsewhere within the Upper Chesapeake region. January inventories for 1953-58 show that the Upper Chesapeake wintering population ranged from zero in 1953 and 1954 to 3,000 in 1958, averaged 1,100. This average figure represents only a small fraction of the total continental population and about 3% of the Atlantic population.

Gadwalls were not known to nest in the Upper Chesapeake region until 1948 (Springer and Stewart, 1950), when several breeding pairs, as well as eggs and young, were observed in Somerset County between Monie Bay and the Manokin River, in the marsh south and southeast of Dames Quarter. This population apparently is successfully established, because breeding pairs have been observed in the area several times in recent years. A few scattered breeding pairs also have been seen in southern Dorchester County, in the large marsh between Savannah Lake and Elliott. The breeding season extends from late April to early August. Extreme egg dates (4 nests) range from May 4 to July 19, and a brood of downy young, about 4 or 5 days old, was observed by F. M. Uhler on July 3.

The fall migration usually is during the period August 20-30 to November 20-30, with the peak between October 10 and November 10. The normal spring migration extends from March 10-20 to April 25-May 5.

## Habitats

Most transient and wintering Gadwalls occur in the slightly brackish estuarine bays of the Central Potomac section. The more common submerged plants in this area are widgeongrass, claspingleaf pondweed, and the introduced Eurasian watermilfoil. Gadwalls in the Blackwater-Nanticoke, Lower Eastern Shore, and Coastal sections, usually frequent the natural "stillwater" ponds and impoundments of the larger marshes. Widgeongrass and muskgrass ordinarily are the most numerous submerged plants in these marshes, although sago pondweed and claspingleaf pondweed are common locally.

Gadwalls breed locally in brackish and salt estuarine bay marshes of the Blackwater-Nanticoke and Lower Eastern Shore sections. We found four nests in this area. One was located at the edge of a thicket along a roadside ditch; one was in an unburned patch of saltmeadow cordgrass in a burned over marsh-meadow; one was in a brushy margin of marsh-meadow composed of saltmeadow cordgrass; and one was on a marsh island in the Manokin River, where the vegetation was chiefly saltmeadow cordgrass and scattered hightide-bush.

## Biogeographic Sections

The average distribution of Gadwalls during the January inventories of 1955-58 was: Central Potomac section, 73%; Lower Potomac section, 11%; Chester River section, 9%; Blackwater-Nanticoke section, 7%; Upper Potomac section, 4%; other sections 0. These figures show the importance of the central Potomac estuary.

Seasonal changes in numbers during 1958-59 are shown in table 66. The Central Potomac section was the outstanding Gadwall area in the region. On at least one survey, fair numbers of Gadwalls also were recorded in the Coastal, Lower Eastern Shore, and Lower Potomac sections.

## Food Habits

The gullet and gizzard food contents of 29 Gadwalls were examined. Data for 24 of these are shown in table 67. Five other birds were collected on fresh estuarine waters of the Upper Potomac section during November and December.

The leaves, stems, and rootstalks of submerged plants were the predominant foods in both series. Widgeongrass was the principal food taken by the birds from the brackish estuarine bay marshes; eelgrass, muskgrass, and claspingleaf pondweed also were consumed in fair amounts. Various seeds, saltgrass rootstalks, and fish were taken in small amounts. Southern naiad was the commonest

food of the Gadwalls from fresh estuarine waters of the Upper Potomac section; small amounts of grassleaf pondweed and red algae also were taken.

## PINTAIL

*Anas acuta* Linnaeus

Pintails are fairly common local winter residents and spring and fall transients, particularly in the areas along the eastern shore of Chesapeake Bay. There are smaller populations in a few scattered locations elsewhere in the region. January inventories for 1953-58 show that the wintering population ranged from 13,900 in 1958 to 66,700 in 1953, averaged approximately 49,600. This average figure represents about 1% of the continental population and 15% of the Atlantic population. The fall migration usually is during the period of August 25 - September 5 to December 10-20, with the peak between October 25 and December 5. The normal spring migration extends from January 15-25 to April 25 - May 5, with the peak between February 15 and March 20.

## Habitats

The optimum combination of habitats for Pintails in the Upper Chesapeake region appears to be the shallow, fresh or brackish estuarine waters and the adjacent agricultural areas with their scattered impoundments. These conditions are widespread along the eastern shore in the area extending from the Bohemia River to the Choptank River. Surveys of wintering populations during 1955-58 showed that, on the average, 50% of the Pintails of the Upper Chesapeake region occurred in this area. Periodic surveys during the 1958-59 season indicated that from 44% to 90% of the total population was found here. The greatest concentrations were in the complex of brackish estuaries and agricultural fields of the Chester River section.

Large numbers of Pintails also occur locally in the extensive estuarine bay marshes and adjoining estuarine river marshes of the Blackwater-Nanticoke and Lower Eastern Shore sections. The 1955-58 winter surveys showed that an average of 47% of the Upper Chesapeake population was in these areas (24% in the fresh and brackish estuarine bay marshes of the Blackwater-Nanticoke section and 23% in the salt estuarine bay marshes of the Lower Eastern Shore section). The periodic surveys in 1958-59 indicated that from 12% to 27% of the Pintails were in these areas during the period from October to January. Numbers were much lower during March after the onset of spring migration.

Pintails also frequent marshes of other sections. During the fall and spring, local

concentrations are present in various estuarine river marshes scattered through the region. In fall, fairly large numbers occur in the marshes and adjoining impoundments of the coastal section.

### Biogeographic Sections

The average distribution of Pintails during the January inventories of 1955-58 is shown in table 68. Approximately 97% of the wintering population occurred in the sections along the eastern shore of Chesapeake Bay; about 2% was in the sections along the western shore (including Patuxent River and Potomac sections); and 1% was in the Coastal section. More than three-fourths of the birds were concentrated in the Chester River, Blackwater-Nanticoke, and Lower Eastern Shore sections.

Seasonal changes in numbers during 1958-59 are shown in table 69. There usually is an influx of early migrants during late August and September. These birds often concentrate on the Susquehanna Flats, and fairly large numbers occasionally remain there through the early part of October. There may be from 500 to 10,000 birds on the flats during this period. The Chester River section was a major Pintail area during all five surveys. Secondary areas included the Lower Eastern Shore and Coastal sections. The principal concentrations of Pintails within these sections were in the central Chester River and lower Chester River areas; in the Smith Island and Tar Bay areas; and in the lower Assateague Island area. Large populations were in the upper Chester River area during the March survey. Other local concentrations of considerable size were in the central and lower Choptank areas of the Choptank River section; in the upper Blackwater area of the Blackwater-Nanticoke section; in the upper Eastern Bay area of the Eastern Bay section; in the bay shore and Sassafras River areas of the Upper Eastern Shore section; in the Port Tobacco area of the Central Potomac section; and in the Patuxent marsh area of the Patuxent River section.

### Food Habits

The gullet and gizzard food contents of 32 Pintails were examined (tables 70-73). Two birds were collected in addition to those shown in the tables. One was shot in the coastal salt marshes during late fall, and the other was collected in the Patuxent River bottomlands in November.

Pintails from the interior impoundments adjoining agricultural fields (table 70) had fed chiefly on corn and on seeds of various weeds characteristic of corn fields, including large-seed smartweed, crabgrass, fall panicum,

foxtail grass, and ladythumb. The Pintails collected along the margins of brackish estuaries (table 71) had fed on seeds of German millet; seeds of various field weeds and aquatic plants; leaves, stems and rootstalks of submerged aquatic plants; corn; and various invertebrates. The principal foods of Pintails from the brackish estuarine bay marsh (table 72) were the seeds of widgeongrass, Olney three-square, twigrush, cordgrass, and crabgrass; the leaves, stems and rootstalks of submerged aquatic plants, particularly widgeongrass; various invertebrate animals; and corn. The Pintails from estuarine river marshes (table 73) had fed primarily on the seeds of dotted smartweed; they also had eaten seeds of halberdleaf tearthumb, common three-square, and many other species. The one bird collected in the coastal salt marshes had fed on corn and on the seeds of saltmarsh cordgrass and widgeongrass. The Pintail taken on the wooded bottomlands of the Patuxent River, an unusual habitat for this species, had fed on the seeds of common burreed, and on various small mollusks (*Physa* sp., *Gyraulus* sp., and *Pisidium atlanticum*).

### Local Distribution of Hunting Kill

Information concerning the local distribution of the hunting kill of Pintails within the Upper Chesapeake region was obtained through an analysis of the distribution of 81 weighted recoveries of birds banded outside of Maryland and Virginia (table 74). These recoveries were reported during the years 1938, 1939, 1940, 1942, 1950, 1951, 1953, 1955, 1956, and 1957. The number per year ranged from 4 in 1938 and 1950 to 13 in 1956.

The Lower Eastern Shore section was the principal area of Pintail kill in the Upper Chesapeake region. Other areas where the kill was fairly high included the Chester River, Coastal, and Upper Eastern Shore sections. The greatest local concentration of kill (15%) apparently occurred in lower Tangier Sound (Fox Island area) of the Lower Eastern Shore section. Other local areas where there were large kills were the lower Chester River (11%), the Taylors Island-Tar Bay area (9%), and the South Marsh Island-Smith Island area (9%). The kill of Pintails as related to their local populations was proportionally high in the Lower Eastern Shore section and proportionally low in the Chester River section. Kill-data arranged by months showed that 36% of the kill was in November, 48% in December, and 16% in January.

### Harvest Areas of Birds Banded in the Upper Chesapeake Region

Data concerning harvest areas of Pintails banded in the Kent Island, Blackwater River,

and Smith Island areas during the years 1950-58 came from 20 indirect band recoveries (table 75). All the recoveries were of birds banded between September 11 and March 4. Three-fourths of the kill was in the mid-Atlantic states. The kill in Maryland was only one-fifth of the total. The eastern Great Lakes area apparently was the most important harvest area along the migration routes.

## GREEN-WINGED TEAL

*Anas carolinensis* Gmelin

The Green-winged Teal is a common fall and spring transient in the tidal marshes of the Upper Chesapeake region. It is present occasionally in other aquatic habitats. Smaller numbers also winter in the region, particularly in the extensive estuarine bay marshes of the Blackwater-Nanticoke and Lower Eastern Shore sections. The fall migration usually is during the period of September 5-15 to December 1-10, with the peak between October 10 and November 25. The normal spring migration extends from February 25 - March 5 to May 1-10, with the peak occurring between March 10 and April 20.

### Habitats

Green-winged Teal are characteristic inhabitants of tidal creeks and ponds of estuarine bay marshes and estuarine river marshes. They ordinarily seem to prefer creeks and ponds that are bordered by exposed expanses of mud at low tide. Often there are large numbers in the marshes and adjoining impoundments of the Coastal section. Scattered flocks or individuals occasionally occur along the margins of the estuarine bays and on interior impoundments.

Seasonal distribution during the 1958-59 season is shown in table 76. The coastal salt marshes and adjoining impoundments were especially important during late fall and early spring, but apparently were not used in winter. The estuarine bay marshes and estuarine river marshes were also of major importance during the fall and spring, and certain areas, particularly the salt estuarine bay marshes, were inhabited in winter.

### Biogeographic Sections

Because of difficulties in censusing Green-winged Teal from the air, fairly large numbers often are missed during regular aerial surveys. The intensive surveys in 1958-59, however, covered the Upper Chesapeake region in sufficient detail so that it was possible to obtain index figures that are believed to be fairly reliable. Results of these seasonal surveys are shown in table 77.

During the fall migration period, over three-fourths of the Green-winged Teal were in the Blackwater-Nanticoke and Coastal sections, and fairly large numbers were in the Patuxent River and Lower Eastern Shore sections. The greater part of the spring population also was in the Blackwater-Nanticoke and Coastal sections, and most of the remaining birds were in the Choptank River and Lower Eastern Shore sections. Wintering birds were restricted to the Lower Eastern Shore and Blackwater-Nanticoke sections. Important local concentration areas for this species include the lower Assateague Island area, upper Nanticoke River marsh, lower Blackwater-Nanticoke marsh, upper Blackwater marsh, Pocomoke Sound marsh, Smith Island, upper Choptank River marsh, and Patuxent River marsh.

### Food Habits

The gullet and gizzard food contents of 47 Green-winged Teal were examined. Locations and results for 42 are shown in tables 78-79. Others included one shot in the coastal marshes in late fall, two shot along the Bush River freshwater estuary in April, and two taken on interior impoundments in March.

Seeds of Olney three-square and widgeon-grass, amphipods, and various small gastropods were the principal foods of the birds from the estuarine bay marsh (table 78). Seeds of dotted smartweed were taken most commonly by birds from the estuarine river marshes; other foods taken often were seeds of softstem bulrush, river bulrush, halberd-leaf tearthumb, and arrowleaf tearthumb (table 79). The single bird from the coastal marshes had fed entirely on bait, chiefly sorghum and wheat. The two birds from the Bush River estuary had fed chiefly on the oogonia of muskgrass. The two birds from interior impoundments had taken seeds of sedge, largeseed smartweed and common beggartick.

### Local Distribution of Hunting Kill

Information concerning local distribution of the hunting kill of Green-winged Teal within the Upper Chesapeake region was obtained through an analysis of the distribution of 12 weighted recoveries of birds that had been banded outside of Maryland and Virginia. These recoveries were reported from the Upper Chesapeake region during eight of the years between 1934 and 1957.

The distribution of the kill based on these weighted recoveries was: Lower Eastern Shore section, 44%; Coastal section, 25%; Blackwater-Nanticoke section 19%; Choptank River section, 6%; and Patuxent River section, 6%. The distribution of the kill as indicated here, although based on very little data,

appears to be closely correlated with the distribution of populations. The greatest local kill (25% of the total) was in southern Dorchester County, southwestern Wicomico County, and northwestern Somerset County, in the area extending eastward from lower Honga River and Bloodsworth Island through Elliott marsh, Ellis Bay marsh, and Dames Quarter marsh. Kill data arranged by months showed that about 70% of the kill was in November and 30% in December.

## BLUE-WINGED TEAL

*Anas discors* Linnaeus

Blue-winged Teal are fairly common local summer residents in the Upper Chesapeake region. They are more widely distributed and common during spring and fall migration. They are local, and uncommon or rare, winter residents. The breeding season generally is from mid-April to early August, with the peak between early May and late June. Extreme egg dates (11 nests) ranged from April 25 (nest with 5 eggs) to June 16. Extreme dates for downy young (25 broods) ranged from May 25 to August 4. The fall migration usually is during the period of August 20-30 to November 10-20, with the peak between September 5 and October 15. The normal spring migration extends from March 10-20 to May 10-20, with the peak between April 5 and May 5.

The occurrence of breeding populations of Blue-winged Teal in the Upper Chesapeake region was not generally known until 1931, when Austin (1932) observed many breeding pairs, as well as eggs and young, in the Dorchester County marshes.

Blue-winged Teal breeding in the tidewater areas along the Atlantic seaboard have been recently described as a distinct race, *Anas discors orphna* (Stewart and Aldrich, 1956). The breeding range extends from New Brunswick, Nova Scotia, and Prince Edward Island to northeastern North Carolina. Careful comparative examination of one winter specimen in the U. S. National Museum and rough field examinations of several freshly shot wintering birds (all from Dorchester County) indicated that most wintering birds in the Upper Chesapeake region also were of the Atlantic coastal race. Detailed examination of numerous museum specimens taken during the migratory season indicated that the migrant populations of the Upper Chesapeake region are chiefly of the interior race, *Anas discors discors* Linnaeus.

## Habitats

Wintering Blue-winged Teal prefer the brackish estuarine bay marshes of the Blackwater-Nanticoke section. Ecological preferences of transients during spring and fall are

similar to those of Green-winged Teal. Both species characteristically inhabit tidal creeks and ponds of estuarine bay marshes and estuarine river marshes; they show some preference for brackish estuarine bay marshes and for fresh or slightly brackish portions of estuarine river marshes. Large numbers often occur in the embayed salt marshes and adjoining impoundments of the Coastal section. Scattered flocks or individuals occasionally occur along the margins of the open-water estuaries and on interior impoundments.

During the breeding season, the greatest numbers are in the brackish estuarine bay marshes of the Blackwater-Nanticoke section. Smaller numbers are in the salt estuarine bay marshes of the Lower Eastern Shore section, and a few pairs inhabit the embayed salt marshes of the Coastal section. Breeding populations are somewhat localized, being restricted mainly to areas that contain fairly extensive salt meadows in combination with adjoining tidal ponds or creeks. A nearly pure stand of saltmeadow cordgrass characterized many of the salt meadows. The vegetation in other meadows was composed of a mixture of saltmeadow cordgrass with saltgrass or saltmarsh cordgrass or both. The mixed stands of vegetation that are especially prevalent in the brackish estuarine bay marshes usually had most birds. An intensive study of breeding waterfowl populations was made in the Blackwater-Nanticoke section in 1956. Part of the study was made on a 160-acre tract of brackish estuarine bay marsh that contained extensive areas of salt meadow and numerous tidal ponds and creeks. A total of ten breeding pairs of Blue-winged Teal occupied this study tract, a density of one pair per 16 acres.

Six Blue-winged Teal nests were found during recent years. Five were in brackish estuarine bay marshes of Dorchester County, and one was in a salt estuarine bay marsh in Somerset County. The principal plant in these marshes was saltmeadow cordgrass, with or without admixtures of saltmarsh cordgrass, saltgrass, and Olney three-square.

## Biogeographic Sections

The small wintering populations of Blue-winged Teal in the Upper Chesapeake region usually are restricted almost entirely to the Blackwater-Nanticoke section. Highest 1-day boat counts were 80 on the Blackwater National Wildlife Refuge on February 22, 1952, and 39 in southern Dorchester County on December 28, 1953.

During the spring and fall migration periods, the greatest numbers are in the extensive marshes of the Blackwater-Nanticoke section. At times, fairly large numbers may be in the marshes of the Lower Eastern Shore and Coastal sections. Local concentrations of birds

are present in other sections, especially in marshes along the upper tidal portions of the Patuxent, Elk, and Choptank Rivers.

The largest breeding populations in the Upper Chesapeake region are in the Blackwater-Nanticoke section. There are small local breeding populations in the Lower Eastern Shore section and a few scattered pairs in the Coastal section. Elsewhere in the tidewater areas of the region, Blue-winged Teal are rare, local, and irregular during the breeding season.

### Food Habits

The gullet and gizzard food contents of 61 Blue-winged Teal were examined. Data for 53 of these are shown in tables 80-81. In addition to these, one half-grown juvenile was collected in the brackish estuarine bay marshes of the Blackwater-Nanticoke section in June. Six birds were shot in wooded river bottomlands along the Patuxent River during September, and one bird was taken on an interior drawdown marsh impoundment of the Patuxent Wildlife Research Center during March.

The seeds of Olney three-square and widgeongrass were the major foods taken by the birds from the estuarine bay marshes (table 80); seeds of saltmarsh bulrush and twigrush were consumed in considerable quantity. Animal foods were especially important during March and June; the principal items were small gastropod mollusks (*Littoridinops* sp.), minute crustaceans (Ostracoda) and beetles (Coleoptera). The single half-grown juvenile collected in this habitat had fed entirely on small gastropods (*Littoridinops* sp.) and crustaceans (Ostracoda). The principal foods consumed by the Blue-winged Teal from estuarine river marshes (table 81) were in the order of their importance: seeds of dotted smartweed, Walter millet, dodder, softstem bulrush, tidemars waterhemp, halberdleaf tearthumb, and common burreed.

All of the six Blue-winged Teal collected in the wooded bottomlands of the Patuxent River had consumed fairly large quantities of certain diminutive mollusks, including the gastropods *Physa* sp. and *Gyraulus* sp. and the pelecypod *Pisidium atlanticum*. The principal vegetable foods were the seeds of Berchtold pondweed, leafy pondweed, southern smartweed, and common burreed. Most of these seeds are not found in the bottomlands, which indicates that the birds had been feeding there for only a brief period.

The Blue-winged Teal collected in the drawdown marsh impoundment had fed almost entirely on the seeds of beakrush and seedbox.

### Harvest Areas of Birds Banded in Upper Chesapeake Region

Data concerning harvest areas of Blue-winged Teal banded on the Blackwater National

Wildlife Refuge during the years 1949-56 came from 19 band-recoveries (table 82). Direct as well as indirect recoveries were used, because the hunting season in Maryland begins after practically all the Blue-winged Teal have departed. Only a very small winter resident population remains. Over half of the kill was in the West Indian-northeast South American areas. About one-fifth of the birds were taken in the eastern Great Lakes - St. Lawrence area, and one-fifth in the north-central States. The kill in Maryland was only 5% of the total.

### SHOVELER

*Spatula clypeata* (Linnaeus)

Shovelers winter in small numbers in certain parts of the Upper Chesapeake region, and are fairly common transients in spring and fall. The fall migration usually is during the period of August 25 - September 5 to December 1-10, with the peak between September 25 and November 10. The normal spring migration extends from March 1-10 to May 1-10, with the peak between March 15 and April 25.

### Habitats

Transient Shovelers and, to a lesser extent, wintering Shovelers ordinarily are well distributed over the fresh and brackish estuarine bay marshes of the Blackwater-Nanticoke section. They usually are most common in the still-water ponds that are subject to slight tidal fluctuations, although at times many also occur at the margins of the brackish bay marsh along the shores of Fishing Bay or the Nanticoke River. The Shoveler populations are much more localized in the salt estuarine bay marshes of the Lower Eastern Shore section and in the embayed salt marshes of the Coastal section. In these saltwater communities, the Shovelers seem to prefer artificial impoundments that have been constructed along guts or creeks of the drainage systems. Shovelers usually occur quite sparsely and irregularly in other waterfowl habitats within the Upper Chesapeake region.

### Biogeographic Sections

Small wintering populations usually are present in the Blackwater-Nanticoke, Lower Eastern Shore, and Coastal sections. Wintering records elsewhere in the region are considered casual.

Shovelers often are fairly common transients in the Blackwater-Nanticoke, Lower Eastern Shore, and Coastal sections during spring and fall, but ordinarily are rather rare in the other tidewater sections and in the coastal plain interior.

Most records are of singles, pairs, or small flocks comprising less than 20 individuals. Highest 1-day ground or boat counts include 55 on the Blackwater National Wildlife Refuge on March 25, 1950 (J. E. Johnson); 40 at Elliott Marsh, Dorchester County, on March 21, 1956; 40+ in the District of Columbia on September 6, 1939 (W. H. Ball); and 40 in the Newport Bay Marsh, Worcester County on February 21, 1954. Highest aerial counts, by C. D. Evans and C. F. Kaczynski, include 1,050 on southern Assateague Island during early December, 1958; 65 in the upper Choptank River marsh during early March 1959; and 61 in the upper Blackwater marsh during early March 1959.

### Food Habits

The gullet and gizzard food contents of 12 Shovelers were examined (table 83). Both vegetable and animal foods apparently are of major importance. The principal vegetable foods include the seeds of Olney three-square, widgeongrass, and saltgrass, and the vegetative parts of muskgrass. The more important animal foods include small gastropod mollusks (*Littoridinops* sp.), minute crustaceans (*Copepoda* etc.) and fish, chiefly top minnows (Poeciliidae).

## EUROPEAN WIDGEON

*Mareca penelope* (Linnaeus)

The European Widgeon is a rare and irregular spring and fall transient and winter visitor throughout the tidewater areas of the Upper Chesapeake region (Stewart and Robbins, 1958). Records are for single birds, or occasionally two birds, at any one location. The earliest arrival date in fall is October 16, and the latest departure date in spring is April 5. European Widgeons usually are found on open-water estuaries or marsh ponds where submerged plants are abundant. They apparently prefer fresh or brackish-water estuarine bays, and ponds in brackish estuarine bay marshes, where they usually are associated with the American Widgeon.

The gullet and gizzard food contents of one bird collected in the Upper Potomac section on December 24, 1927, contained finely ground fragments of pondweeds, probably sago pondweed and naiad.

## AMERICAN WIDGEON

*Mareca americana* (Gmelin)

American Widgeons are among the more common and widespread waterfowl in the Upper Chesapeake region during the fall migration period. They are fairly common also in winter

and spring but are somewhat more local at these seasons. January inventories for the years 1953-58 show that the wintering population ranged from 11,500 in 1958 to 120,400 in 1955, and averaged approximately 62,800. This average figure represents about 4% of the continental population and about 36% of the Atlantic population. The fall migration usually is during the period of September 5-15 to December 10-20, with the peak between October 10 and December 10. The normal spring migration extends from March 1-10 to May 10-20, with the peak between March 15 and April 15.

### Habitats

Most American Widgeons are found on fresh or brackish estuarine bays where submerged plants are abundant. Wild celery and southern naiad usually are the predominant plants in fresh-water bays occupied by the American Widgeons, whereas claspingleaf pondweed and widgeongrass are generally the most abundant species in the brackish-water types. Fairly large numbers of widgeon also are distributed over the salt-water estuarine bays, particularly in areas where eelgrass and widgeongrass are abundant. Local concentrations of birds occur in brackish and salt estuarine bay marshes and in the coastal embayed salt marshes. In these marsh habitats, American Widgeons generally are restricted to natural still-water ponds or artificial impoundments where submerged plants, usually widgeongrass or muskgrass, are abundant. January inventories of 1955-58 showed the following ecological distribution: brackish estuarine bays - 68%; fresh estuarine bays - 13%; combinations of salt estuarine bays and salt estuarine bay marshes - 8%; combination of fresh and brackish estuarine bay marshes - 6%; slightly brackish estuarine bays - 4%; other habitats - 1%.

Seasonal distribution during the 1958-59 season is shown in table 84. The brackish estuarine bays contained from 41% to 85% of the population during the five surveys. Large numbers also were present in fresh estuarine bays in October but were much scarcer in later periods. Fairly large numbers were recorded in the slightly brackish estuarine bays, particularly during the December survey.

### Biogeographic Sections

The average distribution of American Widgeons during the January inventories of 1955-58 is shown in table 85. The Chester River and Eastern Bay sections were the most important wintering areas, the two together containing more than half of the total Upper Chesapeake population. Roughly five-sixths of the birds were in the various sections along the eastern shore of Chesapeake Bay. Most of the

remaining birds were in the Susquehanna Flats and Central Potomac sections.

Intensive aerial population surveys during the fall, winter, and early spring of the 1958-59 season showed seasonal changes in numbers of birds (table 86). Widgeons were most abundant in the Chester River section throughout the season. They were abundant on the Susquehanna Flats during October, but were much scarcer there at other seasons. Fairly large numbers of birds were present in the Central Potomac, Choptank River, Coastal, Eastern Bay, and Blackwater-Nanticoke sections. The greatest local concentrations were recorded in the central Chester River area.

### Food Habits

The gullet and gizzard food contents of 157 American Widgeons were examined. Data for 143 of them are shown in tables 87 and 88. Other miscellaneous collections included two birds taken on the fresh estuarine bay of the Susquehanna Flats in March; six taken on the coastal bays near Chincoteague, Virginia, November to January; three taken on fresh estuarine river marshes in the Patuxent River and Upper Potomac sections during October and March; and three taken on interior impoundments (two from Prince Georges County in March and one from Kent County in January).

Leaves, stems, and rootstalks of submerged plants were the principal foods in all of the major habitats. Claspingleaf pondweed, eelgrass, and widgeongrass were the most important species in the brackish estuarine bays (table 87). Widgeongrass and muskgrass were consumed in greatest quantity in the estuarine bay marshes of the Blackwater-Nanticoke section (table 88). The two birds collected on the Susquehanna Flats had fed on winter buds of wildcelery, rootstalks of undetermined pondweeds and stems of dodder. Large numbers of widgeons on the Susquehanna Flats were observed feeding on the leaves of wildcelery during October 1958.

The six birds collected near Chincoteague, Virginia, had fed entirely on leaves, stems, and rootstalks of eelgrass. The three birds collected in the Patuxent River and Upper Potomac sections had fed on leaves, stems, and rootstalks of common waterweed and sago pondweed and on the seeds of wildrice. The three widgeons shot on interior impoundments had fed on leaves and rootstalks of grass (Gramineae) and on an undetermined pondweed; on the seeds of weak bulrush, panicum, and crabgrass; and on corn and wheat.

### Local Distribution of Hunting Kill

Information concerning local distribution of the hunting kill of American Widgeons within

the Upper Chesapeake region was obtained through an analysis of the distribution of 69 weighted recoveries of birds banded outside of Maryland and Virginia (table 89). These recoveries were reported during the years 1951-58. The number per year ranged from 5 in 1951 to 14 in 1956.

About 70% of the kill was fairly evenly distributed over five sections, the Central Potomac, Choptank River, Eastern Bay, Chester River, and Lower Eastern Shore. The kill of American Widgeons as related to their local populations was proportionally low in the Chester River section. Nearly two-thirds of the kill occurred on brackish estuarine bays, about one-sixth on fresh estuarine bays, and one-sixth in various other habitats. Kill data arranged by months showed that 34% of the kill was in November, 43% in December, and 23% in January.

### Harvest Areas of Birds Banded in the Upper Chesapeake Region

Data concerning harvest areas of American Widgeons banded in the Chester River-Eastern Bay and Gibson Island areas during the years 1953-58 came from 30 indirect band-recoveries (table 90). The birds were banded between January 23 and March 30. Four-fifths of the recoveries were from the mid-Atlantic states. About half the kill was in Maryland alone. The eastern Great Lakes area apparently is the most important harvest area along the migration routes.

### WOOD DUCK

*Aix sponsa* (Linnaeus)

Wood Ducks are fairly common throughout the Upper Chesapeake region during the breeding season. Somewhat larger numbers are present during the spring and fall migration periods. Wintering birds are rare and irregular. The breeding season extends from early March to early September, with the nesting peak from late March to early July. Extreme egg dates (76 nests) ranged from about March 1 to July 25. Extreme dates for downy young (88 broods) ranged from April 14 to September 2 (dates for eggs and downy young supplied by C. G. Webster). The fall migration usually takes place during the period of August 15-25 to November 15-25, with the peak between September 5 and November 5. The normal spring migration extends from February 20 - March 1 to April 10-20, with the peak between March 1 and April 1.

### Habitats

The wooded bottomlands along rivers and the larger creeks are the principal habitat



for the scattered pairs of breeding Wood Ducks and are also of major importance for migrant birds. During the fall flight, Wood Ducks often concentrate in bottomland areas that contain an abundant food supply, especially mast of beech and oaks. Locally, considerable numbers of breeding and migrant Wood Ducks also occur along the wooded margins or marsh fringes of the interior impoundments; they seem to have some preference for impoundments that contain stands of spatterdock. Small numbers may be found in fresh estuarine bay marshes, especially in areas where associations of narrowleaf cattail and white waterlily are predominant.

In spring and fall, and during the post-breeding period in late summer, comparatively large numbers of Wood Ducks also occur in the various estuarine river marshes throughout the region. In these marshes, the greatest numbers of Wood Ducks usually are in the fresh or slightly brackish portions, particularly in areas where arrow-arum is common.

Wood Duck nests ordinarily are in cavities of large deciduous trees, usually more than 10 feet from the ground. Nest cavities are in dead snags as well as in living trees, and may include abandoned tree dens of raccoons and gray squirrels, and old Pileated Woodpecker holes. The erection of nest boxes for Wood Ducks has increased local breeding populations. Methods for construction and location of predator-proof nest boxes are discussed by Webster (1958).

## Biogeographic Sections

During the migration periods, Wood Ducks usually are in small flocks of from 4 to 12 birds. Larger numbers occasionally are recorded on favorite feeding grounds or on roosting areas. Highest 1-day ground or boat counts include the following: 600 at Patuxent Wildlife Research Center, Prince Georges County, on October 19, 1959; 206 in Patuxent estuarine river marsh on September 24, 1947; 145 in Patuxent estuarine river marsh on March 17, 1958; 90 on Nanticoke estuarine river marsh on November 3, 1955. Repeated counts of Wood Ducks in the Patuxent estuarine river marsh area indicate that the total Patuxent marsh population usually ranges between 300 and 500 birds during the migration peak in fall. Other important concentrations of migrant Wood Ducks are in the upper tidewater areas of the following rivers: Pocomoke, Wicomico (in Wicomico County), Nanticoke, Chicamacomico, Transquaking, Blackwater, Choptank, Chester, Sassafas, Elk, Bush, and Gunpowder. Local concentrations also are found in a few areas along the Potomac River, including Allen's Fresh, Port Tobacco River, Nanjemoy Creek, Mattawoman Creek, and Piscataway Creek. In the coastal plain interior, concentrations of birds may be found on some of the mill ponds

in the eastern shore sections, on the numerous impoundments at the Patuxent Wildlife Research Center, and in the wooded bottomlands along the larger streams, including the Patuxent, Nanticoke, and Pocomoke Rivers, and Zekiah Swamp.

## Food Habits

The gullet and gizzard food contents of 79 Wood Ducks were examined. Data for 77 of these are shown in tables 91-92. In addition to these, one bird was collected on an interior impoundment at Remington Farms in Kent County on November 18, and another was taken on the Susquehanna Flats on March 24.

The most important foods of Wood Ducks from the river bottomlands (table 91) were beech nuts and acorns of various oaks, particularly white oak and pin oak. Other foods commonly taken by birds in the bottomlands included the fruits and seeds of a variety of plants, such as halberdleaf tearthumb, hornbeam, and blackgum; and the leaves of submerged plants, particularly ribbonleaf pondweed and Nuttall waterweed. Yearly and seasonal variation in the selection of particular food items seemed to be correlated with changes in the availability of the foods.

The seeds of arrow-arum were the predominant food taken by Wood Ducks in the estuarine river marshes (table 92). A considerable variety of seeds of other marsh plants also were eaten. There was some preference for the larger seeds, including giant burreed and halberdleaf tearthumb.

The Wood Duck collected at Remington Farms had fed chiefly on oak acorns and seeds of dotted smartweed. The Wood Duck collected on the Susquehanna Flats on March 24 had fed chiefly on winter buds of wild celery.

The occurrence of foods in 26 samples of droppings from the Patuxent Wildlife Research Center (examined by C. G. Webster and F. M. Uhler) collected during spring and early summer (March-June) was: oak acorns - 27%; seeds of dotted smartweed - 15%; redroot cyperus - 15%; halberdleaf tearthumb - 12%; corn - 8%; grape - 4%; swamp smartweed - 4%; spatterdock - 4%; greenbrier - 4%; sedge (*Carex canescens*) - 4%; and insect fragments - 11%.

## Local Distribution of Hunting Kill

Information concerning local distribution of the hunting kill of Wood Ducks within the Upper Chesapeake region was obtained through an analysis of the distribution of 29 weighted recoveries of birds banded outside of Maryland and Virginia (table 93). These recoveries were reported during the years 1951-56. The number per year ranged from three in 1955 and 1956 to eight in 1954.

Nearly one-half of the total kill apparently occurs in the Choptank River and Blackwater-Nanticoke sections. The greatest local concentrations of kill also are within these sections, in the estuarine river marshes and wooded swamps along the Choptank and Nanticoke Rivers and their tributaries. The remaining kill is in areas that are fairly well distributed over estuarine river marshes and wooded bottomlands of the other sections. The 10% kill in the coastal plain interior is proportionally much higher than for any other species of waterfowl.

Kill data arranged by months showed that about 70% of the kill was in November, 30% in December, and none in January.

## REDHEAD

*Aythya americana* (Eyton)

The transient and wintering Redheads in the Upper Chesapeake region are somewhat more localized and sporadic than most other waterfowl. In a few areas they often are common or even abundant, whereas in many other areas they are rare or absent. January inventories for the years 1953-58 show that the wintering population ranged from 30,000 in 1958 to 106,200 in 1956, averaged approximately 66,200. This average figure represents about 8% of the continental wintering population and about 44% of the Atlantic population. The fall migration usually is during the period of October 5-15 to December 15-25, with the peak between November 10 and December 10. The normal spring migration period extends from March 1-10 to May 1-10, with the peak between March 15 and April 20.

### Habitats

Wintering Redheads are most numerous in brackish estuarine bays, in areas that contain extensive beds of claspingleaf pondweed, widgeongrass, sago pondweed, and eelgrass. Fairly large numbers also occur in moderately saline estuarine bays in the Tar Bay and Honga River areas of the Lower Eastern Shore section, where the predominant submerged plants are sago pondweed, widgeongrass, and eelgrass.

January inventories of 1955-58 showed the ecological distribution of wintering populations as follows: brackish estuarine bays - 64%; fresh estuarine bays - 14%; salt estuarine bays - 12%; slightly brackish estuarine bays - 8%; and coastal bays - 2%. Thus wintering populations showed a definite preference for brackish-water types.

During the spring and fall migration periods, Redheads seem to prefer fresh and slightly brackish estuarine bays, where they concentrate in localities with an abundance of

submerged plants, particularly wild celery and naiad. Many migrants also occur on brackish estuarine bays that contain large quantities of claspingleaf pondweed and widgeongrass. A few small migrant flocks occasionally are present on interior impoundments, or, rarely, in the estuarine marshes.

Seasonal distribution during the 1958-59 season is shown in table 94. Fresh estuarine bays were the major Redhead habitat during the migration periods, and the brackish estuarine bays were most important in winter. Salt estuarine bays also were used moderately in winter. These shifts in habitat probably are related to the relative severity of weather and ice conditions in different parts of the region.

### Biogeographic Sections

The average distribution of Redheads during the January inventories of 1955-58 is shown in table 95. The Choptank River section is the most important wintering area in the region. About two-thirds of the Upper Chesapeake population was in the various eastern shore sections extending from the Pocomoke River to the Chester River. Most of the remaining birds were fairly evenly divided between the northern portion of Chesapeake Bay (Upper Eastern Shore, Susquehanna Flats, and Upper Western Shore sections) and the western shore area (Central Western Shore, Patuxent River, Central Potomac and Lower Potomac sections).

Intensive aerial population surveys during the fall, winter, and early spring of the 1958-59 season showed seasonal changes in numbers of birds (table 96). The Susquehanna Flats section contained practically all of the Redheads in early November and about three-fourths of them during the first half of March. The majority of the early December population was concentrated in the Upper Western Shore section. Wintering birds were most numerous in the Eastern Bay and Choptank River sections. The greatest local concentrations of Redheads were recorded on the Susquehanna Flats, the upper Eastern Bay, and the Honga River areas, and along the north shore of the lower Choptank River. During other years, large local concentrations have been observed in the Gunpowder-Middle River area of the Upper Western Shore section.

### Food Habits

The gullet and gizzard food contents of 99 Redheads were examined. Data for 98 of these are shown in tables 97-99. In addition to these, a single bird was collected on an interior impoundment of Prince Georges County on March 16.

The leaves, stems, rootstalks, and seeds of various submerged plants were the principal foods in all series. Several species of pondweed and naiad were taken in large quantities in the fresh estuarine bays (table 97). In brackish estuarine bays (table 98), claspingleaf pondweed and eelgrass were the more important species; fair amounts of widgeongrass and common waterweed and considerable quantities of corn used as bait also were taken. In the salt estuarine bays (table 99), bait corn and sorghum were eaten most commonly; various natural foods, including eelgrass, also were taken. The single Redhead collected in Prince Georges County had fed chiefly on midge larvae (Chironomidae).

### Local Distribution of Hunting Kill

Information concerning the local distribution of the hunting kill of Redheads within the Upper Chesapeake region was obtained through an analysis of the distribution of 482 weighted recoveries of birds that had been banded outside Maryland and Virginia (table 100). These recoveries were reported during the years 1950-58. The number per year ranged from 16 in 1950 and 1953 to 173 in 1956.

The Chester River, Lower Eastern Shore, Eastern Bay, and Choptank River sections apparently are the important kill areas for Redheads. Approximately 73% of the total kill was from the brackish and salt estuarine bays along the eastern shore, 17% from the fresh and slightly brackish estuarine bays in the northern portions of Chesapeake Bay, 9% from the brackish estuarine bays along the western shore, and 1% from the coastal salt-water bays. The greater local concentrations of the kill were in the central and lower portions of the Chester River, in the upper part of Eastern Bay, and in the Honga River area. Kill data arranged by months showed that 13% was in November, 46% in December, and 41% in January.

### Harvest Areas of Birds Banded in Upper Chesapeake Region

Data concerning harvest areas of Redheads banded in the Chester River, Eastern Bay, Hooper Island, Solomons, and Gibson Island areas during the years 1953-58 came from 572 indirect recoveries (table 101). Slightly more than half of the 91 birds banded in winter and a little less than half of the 481 banded in spring were taken in the Mid-Atlantic States. About two-fifths of the birds banded in winter and one third of those banded in spring were killed in Maryland alone. Other important harvest areas were in the eastern Great Lakes area and in the North Central States. The greatest concentrations of kill in these two areas were in Michigan and Minnesota.

A more comprehensive analysis of recovery data of Redheads banded in Maryland, including studies of the chronology of migration, sex and age ratios, and mortality rates, was reported by Longwell and Stotts (1958).

### RING-NECKED DUCK

*Aythya collaris* (Donovan)

Ring-necked Ducks are fairly common spring transients through the Upper Chesapeake region, although they are rather local. Somewhat fewer birds stop off during the fall flight, and a few flocks usually remain during the winter. January inventories for the years 1953-58 show that the Upper Chesapeake wintering population ranged from zero in 1954 and 1958 to 6,000 in 1956, averaged approximately 2,400. This average figure represents about 1% of the continental wintering population and about 2% of the Atlantic population. The fall migration usually is during the period October 5-15 to December 1-10, with the peak between October 25 and November 30. The normal spring migration extends from February 10-20 to May 1-10, with the peak between February 20 and April 5.

### Habitats

Wintering Ring-necked Ducks are often found on moderately brackish estuarine bays such as those in the Chester River, Choptank River, and Central Western Shore sections. However, during periods of mild weather, many of them often move to fresh or slightly brackish estuarine bays, fresh estuarine bay marshes, or interior impoundments.

During the spring and fall migration periods, Ring-necked Ducks seem to prefer fresh or slightly brackish estuarine bays and interior impoundments. Considerable numbers of migrants are also distributed over the fresh estuarine bay marshes of the Blackwater-Nanticoke section, and over estuarine river marshes throughout the region.

### Biogeographic Sections

The average distribution of Ring-necked Ducks during the January inventories of 1955-58 is shown in table 102. The Blackwater-Nanticoke section apparently is usually the most important wintering area; within this section, nearly all the Ring-necked Ducks were concentrated in the upper Blackwater marsh.

Seasonal distribution of the Ring-necked Duck populations in tidewater areas during the 1958-59 season is shown in table 103. Largest populations were in the region during the spring flight, a fact borne out by other

more general observations. The actual populations present during spring and fall probably were greater than the figures indicate, because only tidewater habitats were covered during the surveys.

During the 1958-59 season, most early fall migrants were concentrated on the Susquehanna Flats. In December, most birds were distributed over the Chester River, Central Western Shore, Central Potomac and Blackwater-Nanticoke sections. Most of the wintering population was concentrated on the Choptank River, with smaller numbers along the coast and in the Lower Western Shore section. The majority of the spring migrants were distributed over the Upper Eastern Shore, Choptank River, Lower Eastern Shore, and Lower Potomac sections.

### Food Habits

The gullet and gizzard food contents of 34 Ring-necked Ducks were examined. Data for 27 of these are shown in tables 104-105. In addition to these, four birds were taken in the estuarine river marshes along the Patuxent River in March, two were taken on brackish estuarine bays of the Chester River-Eastern Bay area in winter (December 10, February 9), and one bird was collected in a fresh estuarine bay marsh in the Blackwater-Nanticoke section on December 30.

Leaves, stems, and rootstalks of submerged plants; and invertebrate animals were the principal foods eaten by the Ring-necked Ducks collected on fresh estuarine bays (table 104). Commonest items were various pondweeds and the gastropod mollusk (*Oxytrema virginica*). On the interior impoundments (table 105), the principal animal foods included midge larvae (Chironomidae), snout beetles (Curculionidae), and dragonfly nymphs (Libelluloidea); various types of seeds also were eaten. The four Ring-necks from the Patuxent river marshes had fed almost entirely on various seeds; dotted smartweed and arrow-arum were commonest, then halberdleaf tear-thumb, common burreed, spatterdock, and corn (bait). The two birds shot in the Chester River-Eastern Bay area had fed chiefly on leaves, stems, and rootstalks of widgeongrass and claspingleaf pondweed; and various bivalve mollusks, including *Mulinia lateralis*, *Mya arenaria*, and *Brachidontes recurvus*. The Ring-necked Duck collected in the Blackwater-Nanticoke section had fed entirely on corn (bait).

### Local Distribution of Hunting Kill

Information concerning local distribution of the hunting kill of Ringnecked Ducks within the Upper Chesapeake region was obtained through an analysis of the distribution of 26 weighted recoveries of birds banded outside

Maryland and Virginia (table 106). These recoveries were reported from the Upper Chesapeake region during the following years: 1926, 1940, 1943, 1945, 1946, 1947, 1948, 1949, 1950, 1951, 1952, 1955, 1956 and 1958. The number per year ranged from one in 1926, 1945, 1946, 1947, 1948, 1952, and 1955, to four in 1949 and 1950.

Kill of Ring-necked Ducks differed from that of other waterfowl in being mainly in the western shore sections (including Susquehanna Flats, Potomac, and Patuxent sections), where more than two-thirds of the total kill was made. The distribution of the kill by habitat types was: brackish estuarine bays - 50%; fresh and slightly brackish estuarine bays - 45%; salt estuarine bays - 3%; coastal bays - 2%.

### Harvest Areas of Birds Banded in the Upper Chesapeake Region

Data concerning harvest areas of Ring-necked Ducks banded in the Gibson Island, Chester River, and Blackwater River areas during the years 1952-57 came from 38 indirect recoveries, all of birds banded between December 23 and March 16 (table 107). A little more than three-fifths of the kill was in the Mid-Atlantic States. About one-third of the kill was in Maryland alone. Other important harvest areas were in the eastern Great Lakes-St. Lawrence section and in the Southeastern States.

### CANVASBACK

*Aythya valisineria* (Wilson)

Migrant and wintering Canvasbacks usually are numerous and fairly well distributed over the greater part of the Upper Chesapeake region. Great local concentrations occasionally are found in a few choice areas, particularly during the fall migration peak. January inventories for 1953-58 show that the wintering population ranged from 44,000 in 1958 to 351,400 in 1954, averaged approximately 194,300. This average figure represents about 40% of the continental wintering population and about 73% of the Atlantic population. The fall migration usually is during the period from October 15-25 to December 15-25, with the peak between November 15 and December 15. The normal spring migration period extends from February 25 - March 5 to May 1-10, with the peak between March 5 and April 5.

### Habitats

The optimum habitats for Canvasbacks are fresh and brackish estuarine bays that contain

extensive beds of submerged plants or an abundant invertebrate fauna, particularly certain species of thin-shelled clams and small crabs. The fresh-water estuarine bays that are frequented by Canvasbacks usually contain great quantities of wildcelery; in the brackish estuarine bays, claspingleaf pondweed, widgeongrass and sago pondweed are the predominant species, and large quantities of eelgrass occur locally. Canvasbacks are common on the brackish estuarine bays of Fishing Bay and the Nanticoke River in the Blackwater-Nanticoke section. There is very little submerged plant growth in these areas, but invertebrate animals are abundant. Fairly large numbers of Canvasbacks occur in the Coastal section, particularly on or near Heines' Pond (a large impoundment situated near Newport Bay). Small numbers occur in the salt estuarine bays of the Lower Eastern Shore section, and during migration occasional individuals or small flocks may be present on interior impoundments for brief periods.

Brackish estuarine bays are the principal wintering habitat. January inventories for 1955-58 showed the following distribution of the wintering populations among the major habitat types: brackish estuarine bays - 69% (including 58% in areas where submerged plants were abundant and 11% on the Blackwater-Nanticoke areas where there were no submerged vascular plants); slightly brackish estuarine bays - 16%; fresh estuarine bays - 7%; coastal impoundment and bay complex - 5%; and salt estuarine bays - 3%.

The ecological distribution of Canvasback populations during the 1958-59 season is shown in table 108. There were very noticeable changes in habitat distribution during surveys. Birds were most common on the fresh estuarine bays during November and were fairly common there in December and March. The brackish estuarine bay was the most used habitat during December, January, and March. During midwinter of the 1958-59 season, the salt-water areas, and particularly salt estuarine bays, had a considerably greater proportion of Canvasbacks than usual. This probably was a result of the severe weather during the winter months of the 1958-59 season.

## Biogeographic Sections

The average distribution of Canvasbacks during the January inventories of 1955-58 is shown in table 109. The Eastern Bay section apparently is the most important Canvasback wintering area in the Upper Chesapeake region; other important areas include the Central Potomac, Choptank River, Chester River, and Blackwater-Nanticoke sections. About 44% of the total wintering population of the region was in the central eastern shore area (Chester River, Eastern Bay, and Choptank River sec-

tions); 30% was in the Central Western Shore, Potomac, and Patuxent River sections; 13% in the southern portion of the eastern shore area (Blackwater-Nanticoke and Lower Eastern Shore sections); 10% in the northern Chesapeake area (Upper Western Shore, Susquehanna Flats, and Upper Eastern Shore sections); and 5% in the Coastal section.

Seasonal changes in numbers are shown in table 110. The Susquehanna Flats was the principal Canvasback area during the early part of the fall migration period. Later fall migrants were more widely dispersed, and occurred chiefly in the Chester River, Central Potomac, Upper Western Shore, Choptank River, Central Western Shore, and Blackwater-Nanticoke sections. The winter was unusually severe during 1958-59, and this caused large numbers of birds to move to the Lower Western Shore and other sections containing deep estuarine salt water. Spring migrants were most numerous in the Choptank River, Eastern Bay, and Susquehanna Flats sections.

## Food Habits

The gullet and gizzard food contents of 91 Canvasbacks were examined. Data for 86 of these are shown in tables 111-114. In addition to these, one bird was collected on the brackish estuarine bay of the Patuxent River on January 2, and four were taken from the coastal salt bays near Ocean City during December.

Principal foods were leaves, stems, and rootstalks of submerged plants, seeds of various pondweeds, certain species of mollusks and crustaceans, and bait corn. In the fresh estuarine bays (table 111), the leaves, stems, and rootstalks of wildcelery and other aquatic plants were the more important foods; seeds of various pondweeds, including sago pondweed and claspingleaf pondweed also were consumed in considerable quantity. In brackish estuarine bays of the Chester River, Eastern Bay, and Choptank River (table 112), the principal foods were various mollusks and crustaceans, particularly the bivalve *Macoma* (*Macoma balthica*) and mud crabs (*Xanthidae*); leaves, stems, rootstalks and seeds of submerged plants, chiefly claspingleaf pondweed; and bait corn. Various mollusks, chiefly the Baltic macoma, and bait corn were the principal food items in the diet of Canvasbacks from brackish estuarine bays of Fishing Bay and Nanticoke River (table 113), and from salt estuarine bays of the Lower Eastern Shore section (table 114). The four Canvasbacks collected on the coastal salt bays near Ocean City fed chiefly on corn (bait) and on undetermined pelecypod mollusks; they also contained seeds of sago pondweed and undetermined plant fiber. The Canvasback collected on the Patuxent River had fed entirely on *Macoma balthica*.

## Local Distribution of Hunting Kill

Information concerning local distribution of the hunting kill of Canvasbacks within the Upper Chesapeake region was obtained through an analysis of the distribution of 370 weighted recoveries of birds banded outside Maryland and Virginia (table 115). These recoveries were reported during the years 1954-58. The number per year ranged from 40 in 1954 to 97 in 1958.

The Chester River section is the most important harvest area. Approximately 38% of the kill occurred in the central eastern shore area (Chester River, Eastern Bay, and Choptank River sections); 21% in the north Chesapeake area (Upper Western Shore, Susquehanna Flats, and Upper Eastern Shore sections); 16% in the Potomac River sections; 12% in the Blackwater-Nanticoke and Lower Eastern Shore sections; 10% in the Patuxent River and Central and Lower Western Shore sections; and 3% in the Coastal section. The distribution of the kill by habitat was: brackish estuarine bays - 53%; fresh and slightly brackish estuarine bays - 33%; salt estuarine bays - 11%; and coastal bay and impoundment complex - 3%. Kill data arranged by months showed that 14% of the kill was in November, 54% in December, and 32% in January.

## Harvest Areas of Birds Banded in Upper Chesapeake Region

Data concerning harvest areas of Canvasbacks banded in the Chester River, Eastern Bay, Choptank River, Hooper Island, Solomons, Sandy Point (Anne Arundel Co.), and Gibson Island areas during the years 1955-58 came from 338 indirect recoveries (table 116). Recoveries included 132 birds banded in winter and 206 banded in spring. A little more than half of the kill of winter-banded birds and about two-thirds of the kill of spring-banded birds was in the Mid-Atlantic States. Nearly half of the recoveries of winter-banded birds and nearly three-fifths of the recoveries of spring-banded birds were from Maryland alone. Other important harvest areas were in the North Central States, with the greatest (local) concentrations of kill in Minnesota. Fairly large numbers also were taken in the eastern Great Lakes area and in the prairie provinces.

A separate study of the breeding-ground derivation of Canvasbacks killed in the mid-Atlantic states (chiefly Maryland, Virginia, and North Carolina) indicated that about 49% were produced in Saskatchewan, 18% in Manitoba, 16% in Alberta, 11% in North Dakota, and 6% in miscellaneous areas (Stewart, Geis, and Evans, 1958). A fairly comprehensive analysis of recovery data of Canvasbacks banded in Maryland, including studies of the chronology of the migration, sex and age ratios, and mortality rates, was reported by Longwell and Stotts (1958).

## GREATER SCAUP

*Aythya marila* (Linnaeus)

Numbers of Greater Scaup in the Upper Chesapeake region vary greatly from year to year. Fairly large numbers ordinarily are present during severe winters, when Greater Scaup may outnumber Lesser Scaup. During moderate or mild winters, Greater Scaup are much scarcer and are usually outnumbered by Lesser Scaup. The migration periods of the two species seem to be similar (see Lesser Scaup).

Because of the difficulty in distinguishing Greater Scaup from Lesser Scaup in aerial surveys, the counts of the two species were combined, and are presented in the account of the Lesser Scaup.

## Habitats

Greater Scaup ordinarily are largely restricted to brackish and salt estuarine bays and to the coastal bays. Occasionally, during migration, fairly large numbers also occur in fresh and slightly brackish estuarine bays for brief periods. In general, Greater Scaup seem to prefer the coastal bays, Chesapeake Bay proper, and broad expanses of adjoining sounds, bays and estuaries; Lesser Scaup tend to range farther toward the upper limits of the adjoining estuaries.

## Biogeographic Sections

General observations indicate that the principal areas inhabited by Greater Scaup are the Central Western Shore, Chester River, Eastern Bay, Choptank River, Lower Eastern Shore, and Coastal sections.

## Food Habits

The gullet and gizzard food contents of 44 Greater Scaup were examined. Data for 43 of these are shown in tables 117-119. In addition, one bird was collected on Chincoteague Bay during March.

Various small mollusks, including both uni-valve and bivalve types, the leaves, stems, rootstalks, and seeds of submerged plants, and bait corn, were the principal foods consumed by Greater Scaup in the Upper Chesapeake region. In the salt estuarine bays (table 117), various mollusks predominated in the diet, the more important species including the gastropods *Bittium varium*, *Mitrella lunata*, and *Nassarius trivittatus*; eelgrass and bait corn were the chief vegetable foods. Mollusks, and particularly the little surf clam (*Mytilus lateralis*), the bent mussel (*Brachidontes recurvus*) and the gastropod *Bittium varium*, also were the

predominant foods in brackish estuarine bays (table 118), where the more important vegetable foods again included eelgrass and bait corn. Submerged plants and mollusks both were principal foods in the fresh estuarine bays (table 119); the commonest items included the leaves, stems and rootstalks of wildcelery, seeds of pondweeds and the gastropod *Oxytrema virginica*. The single Greater Scaup collected on Chincoteague Bay had fed entirely on the bivalve mollusk *Tagelus divinus*.

### Local Distribution of Hunting Kill

Information concerning local distribution of the hunting kill of Greater Scaup within the Upper Chesapeake region was obtained through an analysis of the distribution of 19 weighted recoveries of birds banded outside Maryland and Virginia. Nine of these recoveries were reported during the 1956 season and ten during 1957.

The distribution of the kill was as follows: Chester River section - 31%; Lower Eastern Shore section - 27%; Central Western Shore section - 17%; Susquehanna Flats section - 10%; Eastern Bay section - 10%; and Coastal section - 5%. Approximately two-thirds of the total kill was in the eastern shore area, from the Chester River to Pocomoke Sound. Kill data arranged by habitat types show that 58% of the kill occurred on brackish estuarine bays, 27% on salt estuarine bays, 10% on fresh and slightly brackish estuarine bays, and 5% on coastal bays. Data arranged by months show that 33% of the kill occurred in November, 45% in December, and 22% in January.

### Harvest Areas of Birds Banded in Upper Chesapeake Region

Data concerning harvest areas of Greater Scaup banded in the Chester River, Eastern Bay, Solomons, and Sandy Point (Anne Arundel Co.) areas during the years 1954-58 came from 37 indirect recoveries (table 120). All of the recovered birds were banded between January 29 and May 4. About four-fifths of the kill occurred in the coastal States from New York to North Carolina. About one-half of the total kill was in Maryland alone. Other fairly important harvest areas were in the Great Lakes-St. Lawrence section; greatest local concentration of kill was in Quebec.

### LESSER SCAUP

*Aythya affinis* (Eyton)

Migrant and wintering Lesser Scaup fluctuate more widely in numbers than do any other species of waterfowl in the Upper Chesapeake region. In many years, Lesser

Scaup are abundant and widespread; during occasional years, they are scarce and much more local.

Population estimates of Greater and Lesser Scaup were combined because of the difficulty in distinguishing the two species during the aerial surveys. During the migration periods, and during most winters (those characterized by moderate or mild weather conditions), the Lesser Scaup ordinarily is the more numerous. January inventories for 1953-58 show that the wintering scaup population (both species combined) ranged from 14,300 in 1958 to 347,600 in 1954, averaged approximately 113,000. This average figure represents about 6% of the continental wintering population, and about 13% of the Atlantic population.

The fall migration usually takes place during the period from September 25 - October 5 to December 15-25, with the peak between November 10 and December 10. The normal spring migration period extends from March 1-10 to May 10-20, with the peak between March 15 and April 20.

### Habitats

The larger migrant populations of Lesser Scaup generally are restricted to fresh, slightly brackish, and brackish estuarine bays. Small numbers usually are scattered over the salt estuarine bays and occasionally a few migrant flocks occur on interior impoundments, particularly during the spring flight. During most years, brackish estuarine bays are the chief wintering habitat. The ecological distribution of Lesser Scaup is not closely correlated with the occurrence of submerged plants, differing in this respect from most other species of waterfowl.

January inventories for the period 1955-58 showed the following distribution of wintering scaup populations (Greater and Lesser Scaup combined): brackish estuarine bays - 73%; coastal bays - 11%; salt estuarine bays - 7%; slightly brackish estuarine bays - 7%; and fresh estuarine bays - 2%.

The ecological distribution of scaup populations (both species combined) during the 1958-59 season is shown in table 121. Over two-thirds of the migrants during early November were in the fresh estuarine bays. The largest concentration of late fall and early spring migrants was in brackish estuarine bays, and fairly large numbers were in fresh, slightly brackish, and salt estuarine bays. The unusually high wintering concentrations of scaup in the salt estuarine bays was a result of the unusually severe weather conditions that year.

### Biogeographic Sections

The average distribution of scaup during the January inventories of 1955-58 is shown



in table 122. Greatest wintering concentrations were in the Central Western Shore and Patuxent River sections; nearly one-half of the total population was in these two areas. Approximately 27% of the scaup were in the various eastern shore sections extending from the Chester River to Pocomoke Sound; 11% were in the coastal area; 9% were in the Potomac River sections; and only 5% in the north Chesapeake area (Upper Western Shore, Susquehanna Flats, and Upper Eastern Shore sections). This distribution is quite different from that of most other waterfowl in the region in that a much larger proportion of the birds are below the Patapsco River in the various western shore sections (including Patuxent and Potomac River sections).

Seasonal changes in numbers are shown in table 123. The early migrant populations in November were largely concentrated in the Susquehanna Flats, Upper Western Shore, and Chester River sections. In December, the late migrant populations were more widely dispersed throughout the Upper Chesapeake region. Over half of the wintering population in January was concentrated in the Lower Western Shore section; most of the remainder was in the Coastal, Eastern Bay, Chester River, and Lower Potomac sections. During the early spring migration in March, the greatest numbers were in the Susquehanna Flats, Central Western Shore, Choptank River, Lower Potomac, Blackwater-Nanticoke, and Lower Eastern Shore sections.

### Food Habits

The gullet and gizzard food contents of 63 Lesser Scaup were examined. Data for 61 of these are shown in tables 124-128. In addition, two were taken on the coastal bays of Worcester County in December.

A variety of small mollusks, representing both gastropod and pelecypod types, were the principal foods of Lesser Scaup in the Upper Chesapeake region. Locally, the seeds, leaves, stems, and rootstalks of submerged plants, and bait, chiefly corn, also were consumed in considerable quantities. In the fresh estuarine bays (table 124), certain mollusks, including the gastropod *Oxytrema virginica*, and the leaves, stems, and rootstalks of a variety of submerged plants were the important foods. In the clear, brackish estuarine bays of the Choptank River, Eastern Bay, and Chester River (table 125), the predominant foods were various mollusks, including the little surf clam (*Mulinia lateralis*), the bent mussel (*Brachidontes recurvus*), and the gem shell (*Gemma gemma*); grain bait, chiefly corn; and the seeds, leaves, stems, and rootstalks of submerged plants, chiefly widgeongrass and claspingleaf pondweed. The more important foods in the turbid brackish estuarine bays of Fishing Bay and the Nanticoke River (table 126) were small gastropod

mollusks, including *Acteocina canaliculata* and *Odosstomia impressa*; small pelecypod mollusks, including the little surf clam (*Mulinia lateralis*), Morton's cockle (*Laevicardium murtoni*), Baltic macoma (*Macoma balthica*), and bent mussel (*Brachidontes recurvus*); and the isopod crustacean *Chiridotea coeca*. In the salt estuarine bays of Dorchester County (table 127), the Lesser Scaup had fed chiefly on small mollusks, including the gastropod *Bittium* sp.; on bait corn; and on the leaves, stems, and rootstalks of eelgrass. The two birds collected in the coastal salt bays of Worcester County had fed on seeds of twigrush; seeds, leaves, and stems of sago pondweed and widgeongrass; and on bait corn. The principal foods taken by the birds shot on interior impoundments (table 128) were dragonfly nymphs (*Libelluloidea*), snout beetles (*Curculionidae*), and the seeds of common burreed.

### Local Distribution of Hunting Kill

Information concerning local distribution of the hunting kill of Lesser Scaup within the Upper Chesapeake region was obtained through an analysis of the distribution of 180 weighted recoveries of birds banded outside Maryland and Virginia (table 129). These recoveries were reported during the years 1955-57. The number per year ranged from 24 in 1955 to 99 in 1956.

The kill of Lesser Scaup is fairly well distributed over the Upper Chesapeake region, with the greatest concentration in the Chester River section. Approximately 27% of the total kill occurs in the central eastern shore area (Chester River, Eastern Bay, and Choptank River sections); 23% in the Potomac River sections; 20% in the north Chesapeake area (Upper Western Shore, Susquehanna Flats, and Upper Eastern Shore sections); 14% in the Central Western Shore - Patuxent River area; 12% in southern portions of the eastern shore area (Blackwater-Nanticoke and Lower Eastern Shore sections); and 4% in the coastal area. The distribution of the kill by major habitat types was: brackish estuarine bays - 53%; fresh and slightly brackish estuarine bays - 32%; salt estuarine bays - 11%; and coastal bays - 4%. The greatest local concentrations of kill were along the Baltimore County "necks" in the Upper Western Shore section, in the St. Clement-Breton Bay area of the Lower Potomac section, and in the Chestertown area of the Chester River section.

Kill data arranged by months showed that 17% of the kill was in November, 59% in December, and 24% in January.

### Harvest Areas of Birds Banded in Upper Chesapeake Region

Data concerning harvest areas of Lesser Scaup banded in the Chester River, Eastern



Bay, Choptank River, Hooper Island, Smiths Creek (St. Marys County), Solomons, and Gibson Island areas during the years 1952-58 (table 130) came from 432 indirect recoveries. The recoveries included 121 from birds banded in winter and 311 from birds banded in spring. Nearly three-fourths of the kill occurred in the Mid-Atlantic States. About one-half of the total kill was in Maryland alone, and there was a fairly large kill in Virginia. Most of the remainder of the kill was in the Eastern Great Lakes - St. Lawrence section, North Central States, prairie provinces, and southeastern states.

A more comprehensive analysis of recovery data of Lesser Scaup banded in Maryland, including studies of the chronology of the migration, sex and age ratios, and mortality rates was reported by Longwell and Stotts (1958).

## COMMON GOLDENEYE

### *Bucephala clangula* (Linnaeus)

Common Goldeneyes are quite generally distributed throughout the Upper Chesapeake region during migration and wintering periods, occurring wherever there are open-water habitats. They usually are in small scattered flocks, although rarely they may concentrate in groups of 1,000 or more individuals.

Population estimates of Common Goldeneyes and Buffleheads were combined because it was difficult to distinguish between them during the aerial surveys. This is not as unsatisfactory as it might seem, however, because the seasonal occurrence and ecological distribution of the two species are quite similar.

January inventories for the years 1953-58 show that the wintering population of Common Goldeneyes and Buffleheads combined ranged from 9,500 in 1958 to 36,100 in 1956, averaged approximately 18,000. This average figure represents about 7% of the continental wintering population of the two species and about 17% of the Atlantic population. Some indication of the relative abundance of Common Goldeneyes and Buffleheads was obtained from counts of birds that were positively identified during numerous local boat and shore censuses. The total count for the two species was 7,421 birds; 5,064 (68%) were Common Goldeneyes and 2,357 (32%) were Buffleheads.

The fall migration of Common Goldeneyes usually is during the period from October 15-25 to December 15-25, with the peak between November 10 and December 10. The normal spring migration period extends from March 1-10 to April 20-30, with the peak between March 15 and April 10.

## Habitats

Migrant and wintering populations of Common Goldeneyes ordinarily are distributed throughout the open estuaries of the Upper Chesapeake region. Brackish estuarine bays apparently are the optimum habitat, although large numbers of birds frequently occur on salt estuarine bays. Common Goldeneyes also occur on slightly brackish estuarine bays and on the coastal bays. Fresh estuarine bays are used most extensively by early fall migrants. During migration, small flocks occasionally may be present on interior impoundments for brief periods.

January inventories of 1955-58 showed the following distribution of wintering populations of Common Goldeneyes and Buffleheads combined: brackish estuarine bays - 61%; salt estuarine bays - 13%; fresh estuarine bays - 13%; coastal bays - 9%; and slightly brackish estuarine bays - 4%.

The ecological distribution of Common Goldeneyes and Buffleheads during the 1958-59 season is shown in table 131. The birds apparently preferred brackish estuarine bays during late fall, winter, and early spring, but used the fresh estuarine bays most commonly in early fall. Considerable numbers were present on salt estuarine bays during all four surveys.

## Biogeographic Sections

The average distribution of Common Goldeneyes and Buffleheads during the January inventories of 1955-58 is shown in table 132. The Choptank River and Eastern Bay sections are the primary winter concentration areas. Nearly two-thirds of the Upper Chesapeake population was in the coastal and eastern shore areas, extending north to Eastern Bay. Fairly large populations also were in the Upper Potomac, Central Western Shore, Patuxent River, and Susquehanna Flats sections.

Seasonal changes in numbers in 1958-59 are shown in table 133. The lower and central eastern shore area extending north to Eastern Bay contained high populations during all four surveys. The north Chesapeake area, particularly the Susquehanna Flats and Upper Western Shore sections, had many birds during November but many fewer during the other months. The central and lower Potomac sections had fairly large numbers of birds during all four surveys.

## Food Habits

The gullet and gizzard food contents of 25 Common Goldeneyes were examined. Data for 23 of these are shown in tables 134-136. Two others were shot on the coastal bays during November and March.

Various crustaceans and mollusks were the predominant foods. Bait corn; the leaves, stems, rootstalks, and seeds of submerged plants; and small fish were commonly eaten in certain local areas. In the fresh estuarine bays (table 134), the principal foods were: the leaves, stems, rootstalks, and seeds of submerged plants, including sago pondweed, other pondweeds, naiad, and wildcelery; and a considerable variety of gastropod and pelecypod mollusks, decapod crustaceans, small fish and insect larvae. Common Goldeneyes collected on brackish estuarine bays (table 135) had fed chiefly on various animal foods, including mud crabs (*Xanthidae*), small fish, ribbed mussels (*Velosella demissa*), and other species of small mollusks and crustaceans; fair amounts of bait corn, and the leaves, stems, and rootstalks of eelgrass and widgeongrass also were taken. The principal foods in the salt estuarine bays (table 136) were bait corn and various crustaceans and mollusks, including mud crabs, bent mussels (*Brachidontes recurvus*), little surf clams (*Mulinia lateralis*), and amphipod crustaceans (*Gammaridae*). The two Common Goldeneyes collected in the coastal bays had fed on the Baltic macoma (*Macoma balthica*); the isopod crustacean *Chiridotea coeca*; amphipod crustaceans; and bait corn.

## BUFFLEHEAD

*Bucephala albeola* (Linnaeus)

Migrant and wintering Buffleheads occur in scattered small flocks throughout the open-water areas of the Upper Chesapeake region. Population estimates of Buffleheads and Common Goldeneyes derived from aerial surveys were combined, because it was difficult to distinguish the two from the air. Results are discussed in the species account for Common Goldeneyes. The fall migration of Buffleheads usually takes place during the period from October 20-30 to December 10-20, with the peak between November 1 and November 30. The normal spring migration period extends from March 10-20 to April 20-30, with the peak between March 25 and April 15.

## Habitats

The habitat distribution of Buffleheads is very similar to that of Common Goldeneyes. Migrant and wintering populations are distributed throughout the various types of open estuaries in the Upper Chesapeake region (table 131). Brackish estuarine bays are the optimum habitat. Fairly large numbers of Buffleheads also occur on salt estuarine bays and on the coastal bays. During the fall flight in November, many occur on the fresh estuarine bays. Small flocks occasionally are found

on interior impoundments during migration. There is some indication that in the tidewater areas Buffleheads habitually go farther up the small tributaries and inlets than do the Common Goldeneyes.

## Biogeographic Sections

The combined population data for Buffleheads and Common Goldeneyes are presented in detail in the species account for Common Goldeneyes and are shown in tables 132 and 133.

## Food Habits

The gullet and gizzard food contents of 25 Buffleheads were examined. Data for 22 of these are shown in tables 137 and 138. Two others were collected on fresh estuarine bays of the Susquehanna Flats and Potomac River during March and October, and another was taken on the coastal bays during early March.

Various species of small crustaceans and mollusks were the predominant foods. Buffleheads collected on the brackish estuarine bays (table 137) had fed chiefly on a considerable variety of crustaceans and mollusks; the predominant species included barnacles (*Balanus* sp.), mud crabs (*Xanthidae*), Baltic macomas (*Macoma balthica*), gem shells (*Gemma gemma*), and numerous other small pelecypod and gastropod mollusks, amphipod and isopod crustaceans, and other invertebrates. Smaller quantities of vegetable food included bait corn, and the leaves, stems, rootstalks, and seeds of widgeongrass, claspingleaf pondweed, and eelgrass. The birds from the salt estuarine bays (table 138) had fed entirely on small mollusks and crustaceans; the principal species included the little surf clam (*Mulinia lateralis*), the Baltic macoma (*Macoma balthica*), and amphipod crustaceans (*Gammaridae*).

The two Buffleheads collected on fresh estuarine bays had fed chiefly on gastropod mollusks, including *Oxytrema virginica*, *Planorbis* sp., and *Amnicola* sp.; on seeds of a pondweed and halberdleaf tearthumb; on leaves of wildcelery; and on mayfly larvae (Ephemeroptera). The Bufflehead collected in the coastal bays had fed entirely on the isopod crustacean *Chiridotea coeca*.

## Harvest Areas of Birds Banded in the Upper Chesapeake Region

Data concerning harvest areas of Buffleheads banded in the Kent Island area during the years 1953-58 came from 29 indirect recoveries (table 139). All recoveries were of birds banded between January 23 and March 30. A little more than two-thirds of the kill

occurred in the Middle Atlantic States. Two-thirds of the total kill was in Maryland alone. Harvest areas of lesser importance were along the migration routes in the eastern Great Lakes area, north-central states, and prairie provinces.

## OLDSQUAW

*Clangula hyemalis* (Linnaeus)

The Oldsquaw, or "south-southerly", as it is called locally, is a common transient and winter resident along the coast and throughout the brackish or salt estuarine bays of the Upper Chesapeake region. Oldsquaws usually are in scattered small flocks, but occasionally they occur in much larger concentrations. They are not generally considered to be a satisfactory gamebird, and very few are shot by hunters. The fall migration ordinarily is during the period from October 20-30 to December 10-20, with the peak between November 5 and December 5. The normal spring migration period extends from March 1-10 to April 20-30, with the peak between March 15 and April 15.

## Habitats

Most Oldsquaws are fairly evenly distributed along the ocean and bays of the Coastal section; in the salt estuarine bays of the Lower Eastern Shore, Lower Western Shore, and Lower Potomac sections; and in the brackish estuarine bays of the Choptank River and Eastern Bay sections. Smaller numbers occur regularly in brackish estuarine bays of the Blackwater-Nanticoke, Chester River, Central Western Shore, Patuxent River, and Lower Potomac sections. Occasionally a few Oldsquaws occur on fresh and slightly brackish estuarine bays of the Upper Eastern Shore, Susquehanna Flats, Upper Western Shore, Central Potomac, and Upper Potomac sections.

## Food Habits

The gullet and gizzard food contents of 6 Oldsquaws were examined (table 140). Animal foods were predominant, and included various crustaceans, bivalve mollusks and small fish. The leaves, stems, and rootstalks of eelgrass and widgeongrass also were consumed, and one bird had taken considerable quantities of bait (wheat and corn).

## WHITE-WINGED SCOTER

*Melanitta deglandi* (Bonaparte)

White-winged Scoters are common transients and winter residents in the coastal areas,

and also are the commonest scoters of Chesapeake Bay proper. White-winged Scoters and other scoters are considered by most duck hunters to be unacceptable game, and very few are shot. The fall migration usually is during the period October 5-15 to December 5-15, with the peak between October 20 and December 1. The normal spring migration period extends from March 10-20 to May 1-10, with the peak between March 25 and April 25.

## Habitats

The optimum habitat for all three species of scoters is the littoral zone of the ocean, in the area just beyond the breakers and within one mile of the shore. The numerous small and large flocks often total many thousands of individuals. The species composition of the flocks varies greatly. Each species may occur alone or in various proportions with the other two. The White-winged Scoter also is common in the coastal bays, in the salt estuarine bays of the Lower Eastern Shore, Lower Western Shore, and Lower Potomac sections, and in the brackish estuarine bays of the Choptank River and Eastern Bay sections. Small numbers occur regularly in the brackish estuarine bays of the Blackwater-Nanticoke, Chester River, Central Western Shore, and Patuxent River sections, and in slightly brackish estuarine bays of the Central Potomac section.

A high local count of 8,000 White-winged Scoters was made on April 6, 1946, in the littoral zone of the ocean between Ocean City, Maryland, and the Delaware - Maryland line. Highest local counts on brackish estuarine bays of the Eastern Bay section included 3,400 on December 29, 1954, and 3,000 on December 1, 1951.

## SURF SCOTER

*Melanitta perspicillata* (Linnaeus)

Very large numbers of transient and wintering Surf Scoters occur in the coastal section, where they usually outnumber the White-winged and Common Scoters. Surf Scoters usually are most abundant in the littoral zone of the ocean, although many occur regularly on the coastal bays. A few occur in the salt estuarine bays of the Lower Eastern Shore, Lower Western Shore, and Lower Potomac sections, and in the brackish estuarine bays of the Choptank River and Eastern Bay sections. In the Chesapeake Bay area, Surf Scoters are greatly outnumbered by White-winged Scoters.

The fall migration of Surf Scoters usually is during the period from October 1-10 to December 1-10, with the peak between October 15 and November 25. The normal spring

migration period extends from February 20 - March 1 to May 1-10, with the peak between March 1 and April 20. A high local count of 19,000 Surf Scoters was made on March 1, 1955, in the littoral zone of the ocean between Ocean City, Maryland, and the Delaware - Maryland line. Another high count of 5,400 was made in the Ocean City area on December 27, 1954.

## COMMON SCOTER

*Oidemia nigra* (Linnaeus)

Transient and wintering Common Scoters usually are restricted to the Coastal section, where they frequently are quite common, although usually less so than either the Surf or White-winged Scoters. The largest populations of Common Scoters generally are in the littoral zone of the ocean. A few Common Scoters occur regularly on the coastal bays, and occasionally on salt and brackish estuarine bays of Chesapeake Bay proper.

The fall migration usually is during the period from September 10-20 to November 20-30, with the peak between October 10 and November 10. The normal spring migration period extends from February 10-20 to May 5-15, with the peak between February 25 and April 25. High local counts include 6,300 on April 6, 1946, in the littoral zone of the ocean between Ocean City, Maryland, and the Delaware - Maryland line; and 2,400 in the Ocean City area on December 27, 1954.

## RUDDY DUCK

*Oxyura jamaicensis* (Gmelin)

Migrant and wintering Ruddy Ducks are very numerous in the Upper Chesapeake region, although their distribution usually is somewhat "spotty". In certain areas, Ruddy Ducks are abundant, whereas in other areas they are quite scarce. January inventories for 1953-58 showed that the wintering populations ranged from 21,400 in 1956 to 102,700 in 1953, averaged approximately 62,400. This average figure represents about 27% of the continental wintering population, and about 59% of the Atlantic population. Ruddy Ducks are unwary, and most hunters consider them third-rate gamebirds and shoot them only as a last resort, when other ducks are not available. Fall migration of Ruddy Ducks usually is during the period from September 15-25 to December 5-15, with the peak between October 25 and November 30. The normal spring migration period extends from March 1-10 to May 10-20, with the peak between March 15 and April 10.

## Habitats

The largest concentrations of transient and wintering Ruddy Ducks are on the slightly brackish estuarine bays of the Upper Western Shore and Central Potomac sections. Considerable numbers also are in brackish estuarine bays and occasionally fairly large flocks are present on salt and fresh estuarine bays. Ruddy Ducks ordinarily are not present on the coastal bays or ocean. Scattered individuals or small flocks may sometimes occur on ponds and creeks of the various tidal marshes, and, during the spring and fall, migrating flocks may stop at interior impoundments for short periods.

January inventories for 1955-58 showed the wintering populations distributed over the major habitat types as follows: slightly brackish estuarine bays - 54%; brackish estuarine bays - 41%; salt estuarine bays - 5%; and fresh estuarine bays - 1%.

Ecological distribution during the 1958-59 season is shown in table 141. Ruddy Ducks differ from other common species of waterfowl in that they occur in the greatest concentrations in slightly brackish estuarine bays, chiefly on the Patapsco and Potomac Rivers, and are present there throughout the season. Considerable numbers also are present on fresh and brackish estuarine bays. The high count shown in the table for salt estuarine bays during January probably is exceptional.

## Biogeographic Sections

The average distribution of wintering populations during 1955-58 is shown in table 142. Nearly four-fifths of the wintering population was in the Lower Potomac, Central Potomac and Upper Western Shore sections. The principal concentration area on the Potomac River lies between Nanjemoy Creek and Breton Bay, whereas the major area within the Upper Western Shore section is along the Patapsco River. Other areas where there were local populations of considerable size include: Fishing Bay and the Nanticoke River on the eastern shore; the Magothy, Severn, South, Rhode, and West Rivers of the central western shore; and the Patuxent River. Ruddy Ducks were relatively scarce or absent elsewhere.

Seasonal changes in numbers during 1958-59 are shown in table 143. The population peak was reached during the fall migration in November, but the greatly lowered population in January may have resulted from the unusually severe weather that winter. The Upper Western Shore and Central Potomac sections were the major concentration areas during the surveys. The unusually large proportion of Ruddy Ducks recorded in the Lower Western Shore section in January probably was due to the severe weather conditions at that time, for the comparatively deep, salt

estuarine bays of this section were among the last areas to freeze in the entire region. Fairly large populations also were present for short periods in the Choptank River, Central Western Shore, Lower Potomac, and Upper Potomac sections.

## Food Habits

The gullet and gizzard food contents of 35 Ruddy Ducks were examined. Data for 29 of these are shown in tables 144-146. In addition, four were taken on brackish estuarine bay marshes of the Blackwater-Nanticoke section during fall (September - November); one was collected in the estuarine river marsh of the Patuxent River during March; and another was collected on the coastal bays, near Ocean City, during December.

The seeds, leaves, and stems of various submerged plants and certain small mollusks and crustaceans were the principal types of food. In the fresh estuarine bays (table 144), leaves, stems and rootstalks of wildcelery were the predominant food; other foods included sago pondweed and the seeds of grass-leaf pondweed; wheat (bait); and certain invertebrates. In the moderately clear, brackish estuarine bays of the Chester, Patuxent and Potomac Rivers (table 145), various mollusks and crustaceans, and particularly the small bivalve *Macoma phenax*, small soft-shelled clams (*Mya arenaria*), and amphipod crustaceans (Gammaridae) were eaten most commonly; seeds of southern naiad, claspingleaf pondweed, and other aquatic plants also were taken in fair amounts. The predominant foods eaten by the Ruddy Ducks collected on the turbid, brackish estuarine bays of Fishing Bay and the Nanticoke River (table 146) included the bivalve Baltic macoma (*Macoma balthica*), the little surf clam (*Mytilus lateralis*), the gastropod *Acteocina canaliculata*, and the isopod crustacean *Chiridotea coeca*. The four Ruddy Ducks collected in brackish estuarine bay marshes of the Blackwater-Nanticoke section had fed on seeds of Olney three-square and widgeongrass, the bivalve *Macoma phenax*, minute shelled crustaceans (Ostracoda) and fish eggs. The bird collected in the estuarine river marsh along the Patuxent River had fed chiefly on seeds of swamp smartweed and paspalum. The bird collected on the coastal bays near Ocean City had fed on undetermined pelecypod mollusks and seeds of widgeongrass and common three-square.

## HOODED MERGANSER

*Lophodytes cucullatus* (Linnaeus)

Hooded Mergansers are fairly common spring and fall transients in the Upper Chesapeake region; they occur in scattered small

flocks wherever habitat conditions are appropriate. Small numbers also are present regularly during the winter. High local counts of Hooded Mergansers were as follows: 200 on Fishing Creek, Anne Arundel County, on April 4, 1956; 100 on Potomac River, off Mount Vernon, Va., on February 8, 1920; 80 on Blackwater National Wildlife Refuge, Dorchester County, on March 21, 1946; 50 in Port Tobacco area, Charles County, on November 19, 1950, and on December 27, 1941. The fall migration usually is during the period from September 25 - October 5 to December 5-15, with the peak between November 1 and November 30. The normal spring migration period extends from February 15-25 to May 5-15, with the peak between March 10 and April 20.

## Habitats

A fairly large proportion of the Hooded Mergansers of the Upper Chesapeake region are found in the fresh and brackish estuarine bay marshes of the Blackwater-Nanticoke section. Scattered flocks also occur regularly in river bottomlands and on interior impoundments and fresh estuarine bays throughout the region. Occasionally a few birds are present in estuarine river marshes, brackish estuarine bays, and other waterfowl habitats.

## Food Habits

The gullet and gizzard food contents of 10 Hooded Mergansers were examined (table 147). Various types of small fish were the predominant food. Other foods included mud crabs (Xanthidae), crayfish (*Cambarus* sp.) dragonfly nymphs (Libelluloidea) and caddisfly larvae (Trichoptera).

## COMMON MERGANSER

*Mergus merganser* Linnaeus

Common Mergansers are common, although rather local, spring and fall transients and winter residents in the Upper Chesapeake region. They usually occur in scattered small flocks of from 6 to 20 individuals. They occasionally may concentrate in much larger numbers on certain favored sites. High local counts are 1,171 on the Blackwater National Wildlife Refuge, Dorchester County, on December 23, 1951; 438 on Susquehanna Flats on December 28, 1951; 400 on Potomac River near Accokeek, Prince Georges County, on December 29, 1944; 242 on Wicomico River, Charles County, on January 2, 1949; 195 on the Gunpowder River, Baltimore County, on March 16, 1947; and 75 on interior impoundments on Patuxent Wildlife Research Center, Prince Georges County, on February 19, 1949.

Fall migration usually is during the period from October 20-30 to December 15-25, with the peak between November 15 and December 10. The normal spring migration extends from February 15-25 to May 5-15, with the peak between March 5 and April 25.

### Habitats

Most Common Mergansers are fairly evenly distributed over the fresh estuarine bays of the Upper Potomac, Upper Western Shore, Susquehanna Flats, and Upper Eastern Shore sections. Many also inhabit the fresh estuarine bay marshes of the Blackwater-Nanticoke section, and a few range into slightly brackish estuarine bays and estuarine river marshes throughout the region. Flocks often visit many of the larger interior impoundments during spring and fall and during open winters.

### Food Habits

The gullet and gizzard food contents of 2 Common Mergansers collected on fresh estuarine bays of the Potomac River during December and January were examined. These birds had fed chiefly on pumpkinseed sunfish (*Lepomis gibbosus*) and yellow perch (*Perca flavescens*).

## RED-BREASTED MERGANSER

*Mergus serrator* Linnaeus

Red-breasted Mergansers are characteristic inhabitants of the more saline tidewaters, in contrast to the Common Mergansers, which occupy the fresh tidewaters. Transient Red-breasted Mergansers are widespread and locally common in the Upper Chesapeake region, and many remain during the winter. High local counts of Red-breasted Mergansers are as follows: 5,000 on Sinepuxent Bay on November 2, 1945; 153 in the Ocean City Inlet area on April 6, 1946; 77 in the St. Michaels area, Eastern Bay, on December 29, 1953; 71 on the Northeast River, Cecil County, on March 31, 1955; and 54 on the Patuxent River on January 12, 1955. The fall migration usually is during the period from October 15-25 to December 10-20, with the peak between November 1 and November 30. The normal spring migration period extends from March 5-15 to May 15-25, with the peak between March 25 and April 25.

### Habitats

Red-breasted Mergansers are most abundant on the coastal bays. They also are fairly common on the ocean, on the salt estuarine bays of the Lower Eastern Shore and Lower

Western Shore sections, and on the brackish estuarine bays of the Choptank River, Eastern Bay, and Lower Potomac sections. Smaller numbers are present at times on the various slightly brackish and fresh estuarine bays, particularly during the migration periods. A few birds stop over on interior impoundments during migration.

### Food Habits

The gullet and gizzard food contents of 5 Red-breasted Mergansers were examined. Three of these were collected on the fresh estuarine bays of the Potomac River, and two were taken in salt estuarine bays of the Lower Eastern Shore section. The Potomac River birds had fed on fish, chiefly sunfish (*Lepomis* sp.) and minnows (Cyprinidae); and on amphipod crustaceans (*Parathemisto gandichaudii*). The lower eastern shore birds had fed on fish, including *Fundulus* sp., and on common prawns (*Palaemonetes vulgaris*).

## AMERICAN COOT

*Fulica americana* Gmelin

Transient American Coots occur in fairly large local concentrations in the Upper Chesapeake region, and many birds usually remain during the winter. "Crowbill" is the common colloquial name for this species. January inventories for 1953-58 show that the wintering population ranged from 8,700 in 1958 to 74,800 in 1955, averaged approximately 31,800. This average figure represents nearly 2% of the continental wintering population and about 5% of the Atlantic population. Most hunters do not consider the American Coot to be a particularly desirable game bird, and as a consequence relatively few birds are harvested. Fall migration usually is during the period from September 20-30 to December 10-20, with the peak between October 20 and December 1. The normal spring migration period extends from March 10-20 to May 5-15, with the peak between March 25 and April 25.

### Habitats

Most of the transient populations of American Coots in the Upper Chesapeake region are on fresh, slightly brackish, and brackish estuarine bays that contain extensive beds of submerged plants. Wintering birds appear to prefer brackish estuarine bays, although many also are present on slightly brackish estuarine bays, and, during mild winters, quite a few remain on fresh-water areas. Occasional transient flocks and a few wintering birds occur in other waterfowl habitats, including fresh estuarine bay marshes, estuarine river marshes, coastal impoundments, and interior impoundments.

January inventory figures for 1955-58 showed the wintering populations distributed over the major habitat types as follows: brackish estuarine bays - 66%; slightly brackish estuarine bays - 17%; fresh estuarine bays - 12%; salt estuarine bays - 3%; fresh and brackish estuarine bay marshes - 2%; and coastal impoundment - bay complex - +%.

Ecological distribution during the 1958-59 season is shown in table 148. Slightly brackish and brackish estuarine bays were the most important habitats. Fresh estuarine bays also were used extensively during the early fall flight. General observations indicated that considerable numbers of American Coots often stop on fresh estuarine bays during the late spring flight in April.

### Biogeographic Sections

The average distribution of wintering populations during 1955-58 is shown in table 149. About one-half of the total Upper Chesapeake wintering population is along the central eastern shore, in the Chester River, Eastern Bay, and Choptank River sections. Other important concentration areas include the Central Potomac, Susquehanna Flats, and Central Western Shore sections.

Seasonal changes in numbers during 1958-59 are shown in table 150. The population peak apparently was reached during the latter part of the fall migration. The great reduction of the population in January probably was due, at least in part, to the unusually severe winter conditions of 1958-59. The Central Potomac and Chester River sections were major concentration areas during all four surveys. Large numbers of birds also were in the Susquehanna Flats and Upper Western Shore sections during the early fall flight. During the winter and spring, the Central Western Shore section was one of the principal areas of concentration. Moderate numbers of American Coots were in the Choptank River section during December and January, but populations in other sections were rather sparse and thinly distributed.

### Food Habits

The gullet and gizzard food contents of four American Coots were examined. One bird

collected on the slightly brackish estuarine bays of the Central Potomac section during October had fed chiefly on leaves, stems, and rootstalks of claspingleaf pondweed, widgeon-grass, and wild celery. Field observations in October indicated that American Coots on the slightly brackish estuarine bay of the Wicomico River in Charles County also were feeding extensively on the leaves of the introduced Eurasian watermilfoil. An American Coot collected in brackish estuarine bay marshes of the Blackwater-Nanticoke section in October had fed on the leaves, stems, and rootstalks of saltgrass, and on water scavenger beetles (Hydrophilidae). Two American Coots collected in estuarine river marshes of the Nanticoke and Patuxent Rivers during March and April had fed chiefly on: leaves, stems, and rootstalks of grass (Gramineae); seeds of arrow-wood, swamp rose, and green brier; and various insects, including water scavenger beetles (Hydrophilidae), earwigs (Dermaptera), mole crickets (*Gryllotalpa* sp.), assassin bugs (Reduviidae), and moth larvae (Lepidoptera).

### Local Distribution of Hunting Kill

Six American Coots banded outside Maryland and Virginia were recovered in the Upper Chesapeake region. These recoveries were taken in the following sections: Chester River, Susquehanna Flats, Upper Western Shore, Central Western Shore, Lower Potomac, and Upper Potomac.

### Harvest Areas of American Coots Banded in the Upper Chesapeake Region

Data concerning harvest areas of American Coots banded in the Chester River, Eastern Bay, Blackwater River, and Hooper Island areas during the years 1955-57 came from 19 indirect recoveries (table 151). All recoveries were of birds banded between February 17 and April 3. About two-fifths of the kill was in the Mid-Atlantic States, with the greatest proportion in North Carolina. About one-sixth of the kill was in Maryland. The greatest kill was in the North Central States, particularly in Wisconsin.



## SUMMARY AND CONCLUSIONS

The Upper Chesapeake region is the chief focal point along the Atlantic coast for vast numbers of migrating waterfowl. Average wintering populations of Whistling Swans, Canada Geese, Black Ducks, and Canvasbacks in the years 1953-58 were the largest known. Very large numbers of American Widgeons, Redheads, Lesser Scaup, and Ruddy Ducks also winter in the region and migrate through it. Fairly large numbers of many other species also are present. Breeding populations of waterfowl in the region also are of considerable importance, at least locally: breeding Black Ducks are common in certain areas along the eastern shore of Chesapeake Bay, and scattered pairs of breeding Wood Ducks are fairly evenly distributed throughout the region.

Wintering waterfowl populations in the region during recent years have averaged more than 1,000,000 birds, and represent about 4% of the continental wintering population and 23% of the Atlantic population. The diving ducks are more abundant than other groups of waterfowl. The predominant species, however, include a general mixture of diving ducks, dabbling ducks, and geese. The combined numbers of Canvasbacks, Canada Geese, Black Ducks, and scaup, constitute more than half of the average wintering population.

Waterfowl populations gradually increase during the fall migration, reaching a peak in December. A slight reduction normally occurs in winter and then a gradual decrease during the spring flight. Dabbling ducks generally predominate in the fall, whereas diving ducks are proportionally more numerous in winter and spring. American Widgeons are the commonest waterfowl during the early fall flight; Canada Geese, Black Ducks, Canvasbacks, and scaup are among the more numerous waterfowl during late fall, winter, and early spring.

Thirteen major types of waterfowl habitat are defined, and the annual and seasonal variations in their waterfowl populations are described. These habitats include six in open tidewater areas: fresh, slightly brackish, brackish, and salt estuarine bays, coastal bays, and the littoral zone of the ocean. Five of the habitats are types of tidal marshes: coastal embayed marshes, salt, brackish, and fresh estuarine bay marshes, and estuarine river marshes. The other two major habitats are within the coastal plain interior and are designated as wooded bottomlands and interior impoundments.

The brackish estuarine bays are the most important habitat for waterfowl populations as a whole. Certain waterfowl such as Whistling Swans, American Widgeons, Canvasbacks, and American Coots occur regularly in winter throughout brackish estuarine bays. Others, including Canada Geese, Mallards, and Black

Ducks, are more restricted to areas that are adjoined by extensive grainfields. Fresh estuarine bays, brackish estuarine bay marshes, and estuarine river marshes also attract large numbers of waterfowl of many kinds. Other habitat types are of importance to fewer species.

Local differences in waterfowl populations within the region prove to be closely correlated with local variations in the preponderance of the different habitats. In some years, the distributional pattern also is influenced by extreme weather conditions. Locally, pollution and turbidity of estuarine waters, and excessive human disturbance, are important in affecting the distribution of waterfowl populations. Fifteen biogeographical sections are defined on the basis of kinds and proportions of habitats and abundance and kinds of waterfowl. These sections include: Upper Potomac, Central Potomac, Lower Potomac, Patuxent River, Lower Western Shore, Central Western Shore, Upper Western Shore, Susquehanna Flats, Upper Eastern Shore, Chester River, Eastern Bay, Choptank River, Blackwater-Nanticoke, Lower Eastern Shore, and Coastal.

The greatest concentrations of transient and wintering waterfowl occur along the central eastern shore of Chesapeake Bay in the Chester River, Eastern Bay, and Choptank River sections. Brackish estuarine bays with large adjoining agricultural fields are the principal waterfowl habitats in these sections. During some years, the Blackwater-Nanticoke section, which contains extensive fresh and brackish estuarine marshes, also had large numbers of waterfowl. The Susquehanna Flats, with their luxuriant beds of fresh-water submerged plants, were one of the principal concentration areas during the spring and fall migration periods. Sections that contained moderate numbers of waterfowl were: Central Potomac, Upper Western Shore, Upper Eastern Shore, Lower Eastern Shore, and Coastal. Sections with relatively few waterfowl were: Upper Potomac, Lower Potomac, Patuxent River, Lower Western Shore, and Central Western Shore.

The quality of habitat in many areas formerly important to waterfowl has deteriorated greatly during recent years. Factors responsible include: pollution and turbidity of fresh and slightly brackish estuarine waters; encroachment of pest plants and animals, including the waterchestnut, Eurasian water-milfoil and carp; use of marshes and other habitats for spoil and trash disposal, and the commercial development of these so-called waste lands; ditching of marshes for mosquito control; and destruction of beds of submerged aquatic plants through clam-dredging operations or by more direct control measures designed to improve swimming and boating.



These drastic habitat changes have had conspicuous local effects, but probably have not greatly reduced the population of the region as a whole. Any general adverse effect on waterfowl populations has been partially offset in a few areas by well-planned programs of habitat improvement. These local programs have benefited geese and dabbling duck populations, but so far very little has been done to improve habitat conditions for diving ducks. However, excellent habitat still prevails in many parts of the Upper Chesapeake region, and it probably is extensive enough to support the numbers of waterfowl available to use this region during recent years. Further destruction or impairment of waterfowl habitat must be halted if a reduction in use of the Upper Chesapeake area is to be avoided.

Federal, State, and private agencies are accelerating their programs toward preserving the waterfowl habitats that still remain. The better-quality areas are being given the highest priority. Data from the present study indicate that the better-quality habitats in the study area include the brackish estuarine bays of the Chester River, Eastern Bay, Choptank River, and their tributaries; the fresh estuarine bay of the Susquehanna Flats; the slightly brackish estuarine bay of the Potomac River and its tributaries; the fresh and brackish estuarine bay marshes of the Blackwater-Nanticoke section; and estuarine river marshes along the Nanticoke, Choptank, and Patuxent Rivers.

Food habits of waterfowl in the Upper Chesapeake region vary greatly from one species to another and from one habitat to another. Variations in foods consumed by any given species appear to be due to differences in availability of foods and so are influenced by habitat and seasonal changes. For the majority of waterfowl, widgeongrass probably is the most important single waterfowl food in the Upper Chesapeake region, and claspingleaf pondweed probably is second most important. Corn also is very important to many kinds of waterfowl. Other food plants important locally are wildcelery, eelgrass, Olney three-square, and dotted smartweed. The more important animal foods in the region are:

the bivalve Baltic macoma (*Macoma balthica*), the little surf clam (*Mulinia lateralis*), the saltmarsh snail (*Melampus bidentatus*), various tiny gastropod mollusks (including *Littoridinops* sp., *Bittium* sp., and *Acteocina canaliculata*), amphipod crustaceans (Gammaridae), mud crabs (Xanthidae) and midge larvae (Chironomidae).

Human disturbance reduces use by waterfowl of many areas that otherwise are suitable. Heavy hunting pressure, in particular, often is important. Disturbance caused by speed boats used for recreation, commercial fishing vessels, or large concentrations of other boats frighten waterfowl from an area. Artillery firing, target bombing, and low-flying planes and helicopters also reduce waterfowl use. Waterfowl of open-water bays and estuaries are especially influenced by hunting, fishing, boating, and similar human activities.

The distribution of the waterfowl kill, in general, was closely correlated with the distribution of populations. The greatest kill occurred along the central eastern shore of Chesapeake Bay in the Chester River, Eastern Bay, and Choptank River sections. Other important areas included the Lower Eastern Shore and Central Potomac sections. The Lower Eastern Shore section was unique in that the kill there of several species including Canada Geese and Pintails was unusually high in relation to their populations. In contrast, the proportional relationship between kill and populations of Canada Geese and Mallards in the Blackwater-Nanticoke section and of Black Ducks, Pintails, and American Widgeons in the Chester River section indicates that the local hunting pressure on these particular species must have been relatively low. The kill of certain waterfowl such as Canvasbacks and American Widgeons was widely distributed over the Upper Chesapeake region, whereas the kill of others, such as Redheads and Pintails, was much more localized.

A study of the harvest areas throughout North America, of waterfowl populations banded in the Upper Chesapeake region, showed that the mid-Atlantic states region was the principal harvest area for most species, and that the greatest concentration of kill was in Maryland.

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# APPENDIX--COMMON AND SCIENTIFIC NAMES OF PLANTS

Alder, smooth ( <i>Alnus serrulata</i> )	Dock, swamp ( <i>Rumex verticillatus</i> )
Arrow-arum ( <i>Peltandra virginica</i> )	Dodder ( <i>Cuscuta</i> sp.)
Arrowhead ( <i>Sagittaria</i> sp.)	Dogwood, silky ( <i>Cornus amomum</i> )
broadleaf ( <i>Sagittaria latifolia</i> )	Duckweed ( <i>Lemna minor</i> )
Ash, red ( <i>Fraxinus pennsylvanica</i> )	Dulichium ( <i>Dulichium arundinaceum</i> )
Aster ( <i>Aster</i> sp.)	Eelgrass ( <i>Zostera marina</i> )
Atriplex ( <i>Atriplex patula</i> )	Enteromorpha ( <i>Enteromorpha</i> sp.)
Bayberry ( <i>Myrica pensylvanica</i> )	False-nettle ( <i>Boehmeria cylindrica</i> )
Beakrush ( <i>Rhynchospora capitellata</i> )	False-pimpernel ( <i>Lindernia dubia</i> )
Beech ( <i>Fagus grandifolia</i> )	Fern
Beggartick	marsh ( <i>Dryopteris thelypteris</i> )
bearded ( <i>Bidens aristosa</i> )	royal ( <i>Osmunda regalis</i> )
common ( <i>Bidens frondosa</i> )	Fimbristylis ( <i>Fimbristylis</i> sp.)
marsh ( <i>Bidens laevis</i> )	Fleabane, saltmarsh ( <i>Pluchea purpurascens</i> )
Birch, river ( <i>Betula nigra</i> )	Foxtail-grass ( <i>Setaria</i> sp.)
Bittercress, Pennsylvania ( <i>Cardamine pensylvanica</i> )	Glasswort ( <i>Salicornia</i> sp.)
Blackberry ( <i>Rubus</i> sp.)	Goldenclub ( <i>Orontium aquaticum</i> )
Blackgum ( <i>Nyssa sylvatica</i> )	Goldenrod, seaside ( <i>Solidago sempervirens</i> )
Black-haw ( <i>Viburnum prunifolium</i> )	Grape ( <i>Vitis</i> sp.)
Blackrush ( <i>Juncus gerardi</i> )	Gratiola ( <i>Gratiola neglecta</i> )
Bladderwort ( <i>Utricularia</i> sp.)	Greenbrier ( <i>Smilax</i> sp.)
Blue-curls ( <i>Trichostema dichotomum</i> )	Groundselbush ( <i>Baccharis halimifolia</i> )
Bulrush ( <i>Scirpus</i> sp.)	Hempweed, climbing ( <i>Mikania scandens</i> )
leafy ( <i>Scirpus polyphyllus</i> )	Hightide-bush ( <i>Iva frutescens</i> )
river ( <i>Scirpus fluviatilis</i> )	Holly ( <i>Ilex</i> sp.)
saltmarsh ( <i>Scirpus robustus</i> )	American ( <i>Ilex opaca</i> )
softstem ( <i>Scirpus validus</i> )	Honeysuckle, Japanese ( <i>Lonicera japonica</i> )
weak ( <i>Scirpus purshianus</i> )	Hornbeam ( <i>Carpinus caroliniana</i> )
Burreed	Iris ( <i>Iris versicolor</i> )
common ( <i>Sparganium americanum</i> )	Jewelweed ( <i>Impatiens capensis</i> )
giant ( <i>Sparganium eurycarpum</i> )	Ladysthumb ( <i>Polygonum persicaria</i> )
Buttonbush ( <i>Cephalanthus occidentalis</i> )	Lythrum ( <i>Lythrum lineare</i> )
Cattail	Mallow, saltmarsh ( <i>Kosteletzkya virginica</i> )
blue ( <i>Typha glauca</i> )	Mannagrass
broadleaf ( <i>Typha latifolia</i> )	Atlantic ( <i>Glyceria obtusa</i> )
narrowleaf ( <i>Typha angustifolia</i> )	eastern ( <i>Glyceria septentrionalis</i> )
southern ( <i>Typha domingensis</i> )	fowl ( <i>Glyceria striata</i> )
Cherry, black ( <i>Prunus serotina</i> )	Maple, red ( <i>Acer rubrum</i> )
Coontail ( <i>Ceratophyllum demersum</i> )	Mermaidweed ( <i>Proserpinaca palustris</i> )
Cordgrass ( <i>Spartina</i> sp.)	Milkweed, swamp ( <i>Asclepias pulchra</i> )
big ( <i>Spartina cynosuroides</i> )	Millet
saltmarsh ( <i>Spartina alterniflora</i> )	German ( <i>Setaria italica</i> )
saltmeadow ( <i>Spartina patens</i> )	Walter ( <i>Echinochloa walteri</i> )
Corn ( <i>Zea mays</i> )	wild ( <i>Echinochloa crusgalli</i> )
Corncockle ( <i>Agrostemma githago</i> )	Muckweed ( <i>Potamogeton crispus</i> )
Crabgrass ( <i>Digitaria</i> sp.)	Muskgrass ( <i>Chara</i> sp.)
Cutgrass, rice ( <i>Leersia oryzoides</i> )	Naiad ( <i>Najas</i> sp.)
Cyperus ( <i>Cyperus</i> sp.)	slender ( <i>Najas gracillima</i> )
redroot ( <i>Cyperus erythrorhizos</i> )	southern ( <i>Najas guadalupensis</i> )

**Needlerush** (*Juncus roemerianus*)  
**Nitella** (*Nitella* sp.)  
**Oak** (*Quercus* sp.)  
     overcup (*Quercus lyrata*)  
     pin (*Quercus palustris*)  
     white (*Quercus alba*)  
     willow (*Quercus phellos*)  
**Panicum** (*Panicum* sp.)  
     fall (*Panicum dichotomiflorum*)  
     warty (*Panicum verrucosum*)  
**Partridge-pea, little** (*Cassia nictitans*)  
**Paspalum** (*Paspalum* sp.)  
**Pennywort, water** (*Hydrocotyle ranunculoides*)  
**Phragmites** (*Phragmites communis*)  
**Pickerelweed** (*Pontederia cordata*)  
**Pilewort** (*Erechtites hieracifolia*)  
**Pine, loblolly** (*Pinus taeda*)  
**Poison-ivy** (*Rhus radicans*)  
**Pondweed** (*Potamogeton* sp.)  
     Berchtold (*Potamogeton berchtoldi*)  
     claspingleaf (*Potamogeton perfoliatus*)  
     grassleaf (*Potamogeton pusillus*)  
     horned (*Zannichellia palustris*)  
     largeleaf (*Potamogeton amplifolius*)  
     leafy (*Potamogeton foliosus*)  
     longleaf (*Potamogeton nodosus*)  
     ribbonleaf (*Potamogeton epihydrus*)  
     sago (*Potamogeton pectinatus*)  
     variableleaf (*Potamogeton gramineus*)  
**Possum-haw** (*Ilex decidua*)  
**Quillwort** (*Isoetes engelmanni*)  
**Riverweed** (*Podostemum ceratophyllum*)  
**Rose, swamp** (*Rosa palustris*)  
**Rosegentian** (*Sabatia stellaris*)  
**Rosemallow** (*Hibiscus moscheutos*)  
**Rush** (*Juncus* sp.)  
**St. John's-wort**  
     little (*Hypericum mutilum*)  
     marsh (*Hypericum virginicum*)  
**Saltgrass** (*Distichlis spicata*)  
**Sea-lavender** (*Limonium carolinianum*)  
**Sea-lettuce** (*Ulva lactuca*)  
**Sedge** (*Carex* sp.)  
     tussock (*Carex stricta*)  
**Seedbox** (*Ludwigia alternifolia*)  
**Smartweed** (*Polygonum* sp.)  
     dotted (*Polygonum punctatum*)  
     largeseed (*Polygonum pennsylvanicum*)  
     marsh (*Polygonum coccineum*)  
     noddling (*Polygonum lapathifolium*)  
     southern (*Polygonum densiflorum*)  
     swamp (*Polygonum hydropiperoides*)  
**Softrush** (*Juncus effusus*)  
**Sorghum** (*Sorghum vulgare*)  
**Spatterdock** (*Nuphar advena*)  
**Spicebush** (*Lindera benzoin*)  
**Spikerush**  
     blunt (*Eleocharis obtusa*)  
     common (*Eleocharis palustris*)  
     dwarf (*Eleocharis parvula*)  
     slender (*Eleocharis acicularis*)  
     squarestem (*Eleocharis quadrangulata*)  
**Spirogyra** (*Spirogyra* sp.)  
**Swamp-candles** (*Lysimachia terrestris*)  
**Sweetbay** (*Magnolia virginiana*)  
**Sweetflag** (*Acorus calamus*)  
**Sweetgum** (*Liquidambar styraciflua*)  
**Switchgrass** (*Panicum virgatum*)  
**Tearthumb**  
     arrowleaf (*Polygonum sagittatum*)  
     halberdleaf (*Polygonum arifolium*)  
**Three-square** (*Scirpus* sp.)  
     common (*Scirpus americanus*)  
     Olney (*Scirpus olneyi*)  
**Tulip-poplar** (*Liriodendron tulipifera*)  
**Twigrush** (*Cladium mariscoides*)  
**Waterchestnut** (*Trapa natans*)  
**Waterhemp, tidemars** (*Acnida cannabina*)  
**Waterlily, white** (*Nymphaea odorata*)  
**Watermilfoil**  
     Eurasian (*Myriophyllum spicatum*)  
     pinnate (*Myriophyllum pinnatum*)  
     slender (*Myriophyllum tenellum*)  
**Waterparsnip** (*Sium suave*)  
**Waterpepper** (*Polygonum hydropiper*)  
**Waterplantain** (*Alisma subcordatum*)  
**Waterpurslane** (*Ludwigia palustris*)  
**Watershield** (*Brasenia schreberi*)  
**Waterstargrass** (*Heteranthera dubia*)  
**Water-starwort** (*Callitriche heterophylla*)  
**Waterweed**  
     common (*Elodea canadensis*)  
     Nuttall (*Elodea nuttallii*)  
**Waxmyrtle** (*Myrica cerifera*)  
**Wheat** (*Triticum aestivum*)  
**Widgeongrass** (*Ruppia maritima*)  
**Wildcelery** (*Vallisneria americana*)  
**Wildrice** (*Zizania aquatica*)  
**Winterberry** (*Ilex verticillata*)  
**Woodbine** (*Parthenocissus quinquefolia*)  
**Woodreed** (*Cinna arundinacea*)  
**Woolgrass** (*Scirpus cyperinus*)  
**Yellow-eyed-grass** (*Xyris* sp.)

## VIEWS OF THE 13 MAJOR HABITAT TYPES IN THIS STUDY

On pages 68 to 74 are photographs of Upper Chesapeake areas representing the 13 major habitat types as defined in the section on Waterfowl Habitats. The photographs are all by Brooke Meanley, except the photograph of a fresh estuarine bay (below) and the photograph of wooded bottomlands (page 74), which are by Frederick C. Schmid, and the photograph of an interior impoundment (page 74), which is by Clark G. Webster.



FRESH ESTUARINE BAYS.  
Susquehanna Flats, at the upper end of Chesapeake Bay.



SLIGHTLY BRACKISH ESTUARINE BAYS.  
Mouth of Port Tobacco River on the Lower Potomac.



BRACKISH ESTUARINE BAYS.  
Kent Island, in Upper Chesapeake Bay.



SALT ESTUARINE BAYS.

Pocomoke Sound, at the southern end of the Upper Chesapeake region.



COASTAL BAYS.

Chincoteague Bay, between Assateague Island and the mainland.





OCEANIC LITTORAL ZONE.  
Atlantic seacoast near Ocean City, Md.



COASTAL EMBAYED SALT MARSHES.  
Edge of Chincoteague Bay.



SALT ESTUARINE BAY MARSHES.  
Marsh near Rumbley in Somerset County, Md.



BRACKISH ESTUARINE BAY MARSHES.  
Marsh near Elliott in Dorchester County, Md.



FRESH ESTUARINE BAY MARSHES.  
Marsh near Savannah Lake in Dorchester County, Md.



ESTUARINE RIVER MARSHES.  
Rail shooting in a marsh along the Patuxent River.



WOODED BOTTOMLANDS.  
Patuxent River at the Patuxent Wildlife Research Center near Laurel, Md.



INTERIOR IMPOUNDMENTS.  
Cash Lake at the Patuxent Wildlife Research Center.

Table 1  
WINTERING POPULATIONS OF WATERFOWL IN THE  
UPPER CHESAPEAKE REGION

	1953	1954	1955	1956	1957	1958	Average 1953-58
Swans	45,000	45,000	72,000	20,000	35,000	17,000	39,000
Geese	222,000	180,000	269,000	242,000	185,000	103,000	200,000
Dabbling Ducks	322,000	239,000	504,000	410,000	300,000	103,000	313,000
Diving Ducks	568,000	837,000	572,000	417,000	231,000	184,000	458,000
Sea Ducks & Mergansers	33,000	24,000	49,000	13,000	13,000	22,000	26,000
Coots	40,000	32,000	75,000	17,000	18,000	9,000	32,000
Unidentified Ducks	12,000	47,000	46,000	3,000	5,000	1,000	19,000
Total Waterfowl	1,242,000	1,404,000	1,529,000	1,122,000	787,000	439,000	1,087,000

Table 2  
SPECIES COMPOSITION OF WINTERING POPULATIONS OF WATERFOWL IN THE  
UPPER CHESAPEAKE REGION (Percentages)

	1953	1954	1955	1956	1957	1958	Average 1953-58
Whistling Swan	4	3	5	2	4	4	4
Canada Goose	18	11	18	20	23	22	17
Brant	+	2	+	1	+	2	1
Snow Goose	0	+	+	+	1	+	+
Mallard	1	2	6	13	12	6	6
Black Duck	11	6	15	13	17	12	12
Gadwall	0	0	+	+	+	1	+
Pintail	5	3	4	6	6	3	5
Green-winged Teal	0	+	0	0	+	+	+
Blue-winged Teal	+	0	0	0	0	0	+
American Widgeon	8	5	8	4	3	3	6
Redhead	4	5	7	9	6	7	6
Ring-necked Duck	+	0	+	1	+	0	+

Table 2  
(Continued)

	1953	1954	1955	1956	1957	1958	Average 1953-58
Canvasback	20	25	16	15	14	10	18
Scaup (Greater & Lesser)	12	25	4	7	3	3	10
Common Goldeneye & Bufflehead	1	1	1	3	2	5	2
Ruddy Duck	8	3	6	2	4	18	6
Oldsquaw	1	1	1	+	+	+	1
Scoters (3 sp.)	1	1	2	1	2	4	2
Mergensers (3 sp.)	+	+	+	+	+	1	+
American Coot	3	3	5	2	2	2	3
Unidentified Ducks	1	3	3	+	1	+	2
Total Percent	100	100	100	100	100	100	100
Total Populations	1,242,000	1,404,000	1,529,000	1,122,000	787,000	439,000	1,087,000

Table 3

SEASONAL CHANGES IN WATERFOWL POPULATIONS IN THE UPPER CHESAPEAKE REGION

	Oct. 2-10, 1958	Nov. 3-12, 1958	Dec. 1-12, 1958	Jan. 7-13, 1959	Mar. 3-16, 1959
Swans	0	600	34,900	23,700	22,200
Geese	7,900	119,900	160,700	150,500	107,300
Dabbling Ducks	61,600	178,100	235,100	198,800	87,500
Diving Ducks	300	119,700	255,500	270,700	262,600
Sea Ducks & Mergansers	800	2,500	2,600	4,300	2,600
Coots	300	17,000	18,400	3,600	5,300
Total Waterfowl	71,000	438,500	707,300	651,500	487,500



Table 4

SEASONAL CHANGES IN SPECIES COMPOSITION OF WATERFOWL POPULATIONS IN THE UPPER CHESAPEAKE REGION  
(Percentages)

	October 2-10, 1958	November 3-12, 1958	December 1-12, 1958	January 7-13, 1959	March 3-16, 1959
Whistling Swan	0	+	5	4	5
Canada Goose	11	27	22	23	21
Brant	0	+	+	+	1
Snow Goose	0	+	+	+	+
Mallard	4	5	7	9	4
Black Duck	18	12	16	17	7
Gadwall	0	+	+	+	+
Pintail	5	4	5	2	2
Green-winged Teal	2	1	+	0	+
Blue-winged Teal	1	+	+	0	+
Shoveler	0	0	+	0	+
American Widgeon	58	18	5	3	4
Wood Duck	+	+	+	0	+
Redhead	0	1	3	8	12
Ring-necked Duck	0	+	+	+	1
Canvasback	0	9	15	16	16
Scaup (Greater & Lesser)	0	2	7	10	14
Common Goldeneye & Bufflehead	0	1	3	4	4
Ruddy Duck	+	14	8	4	6
Oldsquaw	0	+	+	+	+
Scoters (3 sp.)	1	+	+	+	+
Mergansers (3 sp.)	0	+	+	+	+
American Coot	+	5	3	+	1
Total Percent	100	100	100	100	100
Total Populations	71,000	438,500	707,300	651,500	487,500

Table 5

## SAMPLE COUNTS OF WATERFOWL ON FRESH ESTUARINE BAYS

	Sept.	Oct.	Dec.	Jan.-Feb.	Mar.	April
Square Miles Covered	35	75	1.1	.9	20.3	3.2
Whistling Swan	9	10	3,541	672	5,870	45
Canada Goose	6	2,655	1,684	3,230	7,496	10,450
Mallard	165	350	3		2	9
Black Duck	825	2,200	1,453	150	68	162
Gadwall		50				
Pintail	2,355	9,585	517	1	352	
Blue-winged Teal	114	10			1	
American Widgeon	770	32,200	100		347	154
Wood Duck					11	
Redhead		2,300	19	6	114	21
Ring-necked Duck		1,000	165		111	23
Canvasback		17,000	143,868	1,587	3,359	92
Scaup		22,800	25,500	41	2,801	504
Common Goldeneye		10	30	10	29	8
Bufflehead			12		12	2
Ruddy Duck		600	345		67	22
Hooded Merganser			14			
Common Merganser			86	148	58	18
Red-breasted Merganser				3	112	9
American Coot	450	8,483	255		11,797	2,091
Total Waterfowl	4,694	99,253	177,632	5,848	32,607	13,560
Waterfowl per Square Mile	134	1,323	161,484	6,498	1,606	4,237



Table 6

## SAMPLE SHORE COUNTS OF WATERFOWL ON SLIGHTLY BRACKISH ESTUARINE BAYS

	Oct.	Nov.	Dec.	Jan.	Feb.	Mar	April
Square Miles Covered	1.5	.7	.9	1.4	.5	2.6	2.5
Whistling Swan		62	16	175		2,133	6
Canada Goose			15			100	
Mallard		1	2	20		5	
Black Duck	190		160	275		432	3
Gadwall			260				60
Pintail	50		95			12	
Green-winged Teal				1		5	32
American Widgeon	1,750		5,645	2	75	8,672	62
Redhead			355	2		19,505	29
Ring-necked Duck		6	175	455		280	6
Canvasback		457	2,502	3,153	16	627	289
Scaup	22		9		225	8,192	1,010
Common Goldeneye			1	607	37	20	2
Bufflehead		3	2	4		24	31
Ruddy Duck	456	26,173	5,156	10,397	450	7,571	2,230
Common Merganser				59	4	345	
Red-breasted Merganser				2	1	43	62
American Coot	550		4,106	1		222	2,360
Other			12	5		1	15
Total Waterfowl	3,018	26,702	18,511	15,158	808	48,188	6,187
Waterfowl per Square Mile	2,012	38,146	20,568	10,827	1,616	18,534	2,479

Table 7

## SAMPLE SHORE COUNTS OF WATERFOWL ON BRACKISH ESTUARINE BAYS

	With Large Agricultural Fields: Eastern Shore Area			Without Large Agricultural Fields: Western Shore Areas				Blackwater -Nanticoke Area	
	Dec.	Feb.	Mar.	Nov.	Jan.	Mar.	April	Dec.-Jan.	Feb.-Mar.
Square Miles Covered	8.1	1.6	2.4	3.0	6.2	.8	3.4	.6	1.4
Whistling Swan	6,050	873	1,943	538	929	0	0	0	0
Canada Goose	36,812	1,634	1,135	65	56	0	0	0	0
Mallard	11,677	32	3	15	86	7	0	0	10
Black Duck	5,378	531	507	56	382	15	7	0	95
Pintail	6,624	73	0	9	0	0	0	0	0
American Widgeon	3,375	902	337	487	2,006	4	2	0	0
Redhead	13,214	522	10	63	718	0	43	300	0
Ring-necked Duck	0	50	15	10	78	0	0	0	0
Canvasback	10,610	615	1,252	5,986	17,298	15	1,376	340	2,140
Scaup	98	1,548	3,038	133	956	555	4,376	350	426
Common Goldeneye	1,272	358	410	60	798	13	4	7	0
Bufflehead	130	57	8	42	430	70	236	0	0
Oldsquaw	114	121	341	19	792	41	8	0	0
White-winged Scoter	19	0	237	1	29	0	0	0	0
Ruddy Duck	1,244	23	0	1,283	13,155	614	7,317	165	12,870
Red-breasted Merganser	67	23	48	7	56	29	10	0	0
American Coot	4,424	885	1,206	1	1,508	0	321	0	0
Other	279	15	60	9	15	1	200	10	90
Total Waterfowl	101,387	8,262	10,500	8,784	39,292	1,364	13,900	1,172	15,631
Waterfowl per Square Mile	12,517	5,164	4,396	2,928	6,637	1,705	4,088	1,953	11,165

Table 8

## SAMPLE COUNTS OF WATERFOWL ON SALT ESTUARINE BAYS

	Jan.	Feb.	March	April
Square Miles Covered	3.1	.2	1.9	1.8
Green-winged Teal			2	
Blue-winged Teal			2	
American Widgeon		4		
Redhead	45			
Scaup	27	15	21	52
Common Goldeneye	748	15	84	
Bufflehead	340	10	29	62
Oldsquaw	1,203	30	34	72
White-winged Scoter	78	1	1	117
Surf Scoter	47	2	10	53
Ruddy Duck	440			5
Red-breasted Merganser	5	1	27	20
Unidentified Ducks	33			
Total Waterfowl	2,966	78	210	381
Waterfowl per Square Mile	957	390	111	212

Table 9

SAMPLE COUNTS OF WATERFOWL ON COASTAL BAYS<sup>1</sup>

	December	January- February	March
Whistling Swan	1		
Canada Goose	158	100	155
Brant	3,700	6,300	8,260
Snow Goose		4	
Mallard			1
Black Duck	1,618	258	53
American Widgeon	1		
Canvasback	600	100	
Scaup	13,040	200	403
Common Goldeneye	109	90	35
Bufflehead	587	34	8
Oldsquaw	1,180	25	25
White-winged Scoter	548	4	10
Surf Scoter	1,100	2	51
Common Scoter			3
Ruddy Duck		1	
Red-breasted Merganser	8	113	156
Total	22,650	7,231	9,160

<sup>1</sup> These data were recorded during general coverages of the coastal bays rather than on systematic censuses of measured areas.

Table 10

SAMPLE COUNTS OF WATERFOWL  
IN BRACKISH ESTUARINE BAY MARSHES OF DORCHESTER COUNTY (1954-57)

	Sept.-Oct.	Nov.-Dec.	Mar.-April	May-June	July-Aug.
Square Miles Covered	2.1	2.3	5.7	17.6	11.2
Whistling Swan		2	10		
Canada Goose		10			
Mallard		20	4	1	1
Black Duck	60	447	644	579	359
Gadwall		13	14	2	
Green-winged Teal	3	6	336	29	
Blue-winged Teal	516	152	115	116	28
Shoveler			12	1	
American Widgeon		20	156		
Common Goldeneye		3			
Ruddy Duck	1				
Hooded Merganser		3			
Common Merganser		8			
Total Waterfowl	580	684	1291	728	388
Waterfowl per Square Mile	276	297	226	41	35

Table 11

WATERFOWL KILL BY ELLIOTT MARSH GUN CLUB, 1955-58, ON 700-ACRE  
TRACT OF BRACKISH ESTUARINE BAY MARSH IN  
SOUTHERN DORCHESTER COUNTY, MD.

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American Widgeon	251	(39%)
Black Duck	214	(33%)
Mallard	57	( 9%)
Gadwall	27	( 4%)
Green-winged Teal	25	( 4%)
Pintail	20	( 3%)
Hooded Merganser	12	( 2%)
Shoveler	11	( 2%)
Blue-winged Teal	10	( 1%)
Canvasback	5	( +%)
Bufflehead	4	( +%)
Canada Goose	3	( +%)
Ruddy Duck	3	( +%)
Redhead	2	( +%)
Common Goldeneye	2	( +%)
Blue Goose	1	( +%)
Lesser Scaup	1	( +%)
Total	648	(100%)

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Table 12

SAMPLE COUNTS OF WATERFOWL IN FRESH ESTUARINE BAY MARSHES  
(1946-57)

	Oct.	Nov.	Mar.	April
Square Miles Covered	.4	.8	4.2	.8
Whistling Swan		5	162	
Canada Goose		1000	6020	1306
Mallard	10	10		
Black Duck	40	70	289	6
Gadwall		150	700	7
Pintail		11	22	
Blue-winged Teal	150		10	30
Shoveler			6	
American Widgeon	40	1602	31	8
Ring-necked Duck		40	8	
Canvasback			30	
Ruddy Duck	1	19	17	
Common Merganser			4	
American Coot		610		
Total Waterfowl	241	3517	7299	1357
Waterfowl per Square Mile	602	4396	1738	1696

Table 13

## SAMPLE COUNTS OF WATERFOWL IN ESTUARINE RIVER MARSHES (1955-58)

	Sept.	Oct.	Nov.	Jan.	Mar.	April
Square Miles Covered	7.4	17.0	3.3	1.6	8.4	6.3
Canada Goose		200			300	
Mallard	59	1313	410	2	1176	69
Black Duck	119	1001	320		328	106
Pintail	50	220	1	100	92	16
Green-winged Teal	10	370	26		230	166
Blue-winged Teal	52	243			302	175
American Widgeon	10	161			36	55
Wood Duck	217	377	90		189	44
Ring-necked Duck		22			56	4
Ruddy Duck		11				
Hooded Merganser		4			1	
Common Merganser					11	10
American Coot		102			23	3
Other Species		10			2	
Total Waterfowl	517	4034	847	102	2746	648
Waterfowl per Square Mile	70	237	257	64	327	103



Table 14

## CHARACTERISTIC PLANTS OF INTERIOR IMPOUNDMENTS

<u>Open-water Zone</u>	<u>Secondary Species</u>
<u>Primary Species</u>	Yellow-eyed-grass
Berkthold Pondweed	Rush ( <u>Juncus scirpoides</u> )
Slender Spikerush	Rush ( <u>Juncus canadensis</u> )
Spatterdock	Swamp Rose
Bladderwort ( <u>Utricularia geminiscapa</u> )	Little St. John's-wort
Bladderwort ( <u>Utricularia gibba</u> )	Marsh St. John's Wort
<u>Secondary Species</u>	Seedbox
Pondweed ( <u>Potamogeton diversifolius</u> )	Silky Dogwood
Nuttall Waterweed	Swamp-candles
White Waterlily	<u>Draw-down Zone</u>
Watershield	<u>Primary Species</u>
Mermaidweed	Rice Cutgrass
Bladderwort ( <u>Utricularia vulgaris</u> )	Warty Panicum
<u>Shore-line Zone</u>	Fall Panicum
<u>Primary Species</u>	Wild Millet
Broadleaf Cattail	Redroot Cyperus
Common Burreed	Slender Spikerush
Woolgrass	Fimbristylis ( <u>F. autumnalis</u> )
Sedge ( <u>Carex lurida</u> )	Weak Bulrush
Softrush	Largeseed Smartweed
Rush ( <u>Juncus acuminatus</u> )	Dotted Smartweed
Smooth alder	Arrowleaf Tearthumb
Buttonbush	Halberdleaf Tearthumb
<u>Secondary Species</u>	Waterpurslane
Marsh Fern	Common Beggartick
Waterplantain	<u>Secondary Species</u>
Broadleaf Arrowhead	Cyperus ( <u>C. odoratus</u> )
Atlantic Mannagrass	Cyperus ( <u>C. strigosus</u> )
Panicum ( <u>P. agrostoides</u> )	Blunt Spikerush
Panicum ( <u>P. microcarpon</u> )	Waterpepper
Dulichium	Gratiola
Beakrush	False-pimpernal
Sedge ( <u>Carex crinita</u> )	Bearded Beggartick
Duckweed	Pilewort

Table 15

SAMPLE COUNTS OF WATERFOWL ON TWO INTERIOR IMPOUNDMENTS (TOTALING 95 ACRES)  
ON THE PATUXENT WILDLIFE RESEARCH CENTER

	Oct. 26, 1955	Nov. 5, 1955	Nov. 28, 1955	Dec. 19, 1959	Dec. 27, 1954	Jan. 22, 1955	Feb. 26, 1959	Mar. 6, 1955	Apr. 7, 1954	Apr. 15, 1954
Canada Goose	150	105	145	230	24	40	180		34	30
Blue Goose	1	1								
Mallard	38	142	200	250	130	330	30	132	20	2
Black Duck	40	24	25	350	55	87	25	39	24	10
Gadwall	5			1		3		2		
Pintail	2	3			1			21		
Green-winged Teal		6		26				2	1	3
American Widgeon	1	15	3						22	9
Wood Duck	1	1							1	5
Redhead	2	6					12		2	1
Ring-necked Duck	26	68	200	430	10	45	250	488	104	40
Canvasback	3									
Lesser Scaup									3	
Bufflehead										2
Ruddy Duck		18	2	1					3	
Hooded Merganser			13	12			3	4	1	
American Coot									8	8
Total Waterfowl	269	389	588	1,300	220	505	500	688	223	110
Waterfowl per Square Mile	1,813	2,622	3,963	8,762	1,483	3,404	3,370	4,637	1,503	741

Table 16

BIOGEOGRAPHICAL DISTRIBUTION OF WINTERING POPULATIONS OF  
WATERFOWL IN THE UPPER CHESAPEAKE REGION: AVERAGES FOR 1955-58

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Upper Potomac Section	1%
Central Potomac Section	5%
Lower Potomac Section	3%
Patuxent River Section	3%
Lower Western Shore Section	4%
Central Western Shore Section	4%
Upper Western Shore Section	3%
Susquehanna Flats Section	3%
Upper Eastern Shore Section	6%
Chester River Section	21%
Eastern Bay Section	14%
Choptank River Section	12%
Blackwater-Nanticoke Section	13%
Lower Eastern Shore Section	7%
Coastal Section	5%
Total [Percent]	100%
Total [Population]	966,550

Table 17

SEASONAL CHANGES IN BIOGEOGRAPHICAL DISTRIBUTION OF WATERFOWL  
POPULATIONS IN THE UPPER CHESAPEAKE REGION (PERCENTAGES)

	Oct.2-10, 1958	Nov.3-12, 1958	Dec.1-12, 1958	Jan.7-13, 1959	Mar.3-16, 1959
Upper Potomac Section	+	+	1	+	2
Central Potomac Section	7	7	9	5	6
Lower Potomac Section	1	+	1	3	4
Patuxent River Section	1	2	2	1	1
Lower Western Shore Section	+	+	1	11	1
Central Western Shore Section	1	1	2	1	5
Upper Western Shore Section	+	13	10	2	5
Susquehanna Flats Section	19	13	2	1	16
Upper Eastern Shore Section	8	5	5	4	10
Chester River Section	28	25	29	24	15
Eastern Bay Section	6	4	9	18	10
Choptank River Section	6	9	12	16	13
Blackwater-Nanticoke Section	10	9	4	3	5
Lower Eastern Shore Section	6	4	7	6	4
Coastal Section	7	8	6	5	3
TOTAL PERCENT	100	100	100	100	100
TOTAL POPULATIONS	71,000	439,000	707,000	652,000	488,000

Table 18

## SPECIES COMPOSITION OF WATERFOWL POPULATIONS IN THE UPPER POTOMAC SECTION

	January Populations: Average Percentages, 1955-58	Seasonal Population Changes in 1958-59 (Percentages)				
		Oct.2-10	Nov.3-12	Dec.1-12	Jan.7-13	Mar.3-16
Whistling Swan	+				2	6
Canada Goose	1		13		11	
Mallard	17	2	3	1	20	+
Black Duck	14	6	28	4	22	8
Gadwall						+
Pintail	+		1			+
Green-winged Teal						+
Shoveler						+
American Widgeon						+
Redhead						26
Ring-necked Duck				1		+
Canvasback	16			6	11	26
Scaup	3			8		13
Common Goldeneye and Bufflehead	20		1	10	26	2
Oldsquaw	1					
Ruddy Duck	1	80	54	66		17
Mergansers	5			+		2
American Coot	9			4	8	
Unidentified Ducks	13	12				
Total Percent	100	100	100	100	100	100
Total Population	6,400	200	800	7,700	400	7,600

Table 19

## SPECIES COMPOSITION OF WATERFOWL POPULATIONS IN THE CENTRAL POTOMAC SECTION

	January Populations: Average Percentages, 1955-58	Seasonal Population Changes in 1958-59 (Percentages)				
		Oct.2-10	Nov.3-12	Dec.1-12	Jan.7-13	Mar.3-16
Whistling Swan	2		1	3	5	1
Canada Goose	1	+	3	2	3	+
Mallard	2	1	3	2	2	1
Black Duck	6	4	4	5	8	3
Gadwall	2		6	2	2	6
Pintail	1	+	1	4		
Green-winged Teal			+	+		
Blue-winged Teal						+
American Widgeon	4	91	32	15	4	9
Wood Duck			+			
Redhead	10			+		3
Ring-necked Duck	+		+	1	+	1
Canvasback	37		2	31	42	27
Scaup	3			10	3	14
Common Goldeneye and Bufflehead	1		2	3	16	1
Oldsquaw			+	+		
Scoters	+		+	+	+	+
Ruddy Duck	20		40	9	13	23
Mergansers	1				+	+
American Coot	10	4	6	13	2	11
Unidentified Ducks	+		+			
Total Percent	100	100	100	100	100	100
Total Population	48,500	5,000	32,200	62,700	33,100	27,100

Table 20

**SPECIES COMPOSITION OF WATERFOWL POPULATIONS IN THE LOWER POTOMAC SECTION**

	January Populations: Average Percentages, 1955-58	Seasonal Population Changes in 1958-59 (Percentages)				
		Oct.2-10	Nov.3-12	Dec.1-12	Jan.7-13	Mar.3-16
Whistling Swan	4			2	3	3
Canada Goose	3	40	31	11	4	1
Mallard	+		2	5	3	1
Black Duck	1		8	2	4	1
Gadwall	+			+	+	+
Pintail	+		+			
American Widgeon	1	60	38	13	8	6
Wood Duck		+				
Redhead	12			2	+	4
Ring-necked Duck				1	+	3
Canvasback	7			7	30	24
Scaup	7			12	23	35
Common Goldeneye and Bufflehead	2			20	12	9
Oldsquaw	7		2	2	6	+
Scoters	4		+	2	1	1
Ruddy Duck	42		17	18	6	12
Mergansers	2			+	+	+
American Coot	4			1		+
Unidentified Ducks	4			+		
Total Percent	100	100	100	100	100	100
Total Population	32,200	600	2,100	8,300	20,800	20,000

Table 21

## SPECIES COMPOSITION OF WATERFOWL POPULATIONS IN THE PATUXENT RIVER SECTION

	January Populations: Average Percentages, 1955-58	Seasonal Population Changes in 1958-59 (Percentages)				
		Oct.2-10	Nov.3-12	Dec.1-12	Jan.7-13	Mar.3-16
Whistling Swan	1		+	7	19	10
Canada Goose	1	3		+		+
Mallard	3	18	29	12	16	14
Black Duck	5	35	17	9	17	8
Pintail	1		8	1		9
Green-winged Teal		5	8			+
Blue-winged Teal		+				
American Widgeon	1	35	34	4	2	1
Wood Duck		+	+	+		+
Redhead	5			8	2	
Ring-necked Duck						+
Canvasback	31			11	35	11
Scaup	35			36		17
Common Goldeneye and Bufflehead	4		+	3	7	11
Oldsquaw	+			+	+	+
Scoters	+			1		+
Ruddy Duck	7	3	2	4	2	15
Mergansers	1			+	+	1
American Coot	5		1	2		1
Unidentified Ducks	+			1		
Total Percent	100	100	100	100	100	100
Total Populations	29,900	1,000	7,400	14,800	4,100	6,700



Table 22

SPECIES COMPOSITION OF WATERFOWL POPULATIONS IN THE LOWER WESTERN  
SHORE SECTION

	January Populations: Average Percentages, 1955-58	Seasonal Population Changes in 1958-59 (Percentages)			
		Nov.3-12	Dec.1-12	Jan.7-13	Mar.3-16
Whistling Swan	+			+	4
Mallard				+	
Black Duck	+	2	+	+	1
Green-winged Teal					+
American Widgeon	9			+	4
Redhead				+	
Ring-necked Duck				+	
Canvasback	22		3	36	
Scaup	20		83	53	1
Common Goldeneye and Bufflehead		1	8	3	50
Oldsquaw	3	64	+	+	6
Scoters	42	7	6	1	34
Ruddy Duck		26		6	
Mergansers	4			+	
American Coot		+	+	+	
Total Percent	100	100	100	100	100
Total Populations	2,900	500	5,200	71,500	2,300

Table 23

SPECIES COMPOSITION OF WATERFOWL POPULATIONS IN THE CENTRAL WESTERN  
SHORE SECTION

	January Populations: Average Percentages, 1955-58	Seasonal Population Changes in 1958-59 (Percentages)				
		Oct.2-10	Nov.3-12	Dec.1-12	Jan.7-13	Mar.3-16
Whistling Swan	9			14	23	2
Canada Goose				1	+	
Mallard	+	12	+	+	+	
Black Duck	+	7	2	2	1	+
American Widgeon	+	50	28	14	11	1
Redhead	2			3		+
Ring-necked Duck				4	+	1
Canvasback	27			46	35	12
Scaup	31			+		58
Common Goldeneye and Bufflehead	4			3	8	4
Oldsquaw	+					
Scoters	12					
Ruddy Duck	6	24	50	7	+	17
Mergansers	1					+
American Coot	7	4	19	6	19	4
Unidentified Ducks	+	3				
Total Percent	100	100	100	100	100	100
Total Populations	34,900	700	4,600	15,100	8,300	24,000

Table 24

SPECIES COMPOSITION OF WATERFOWL POPULATIONS IN THE UPPER WESTERN  
SHORE SECTION

	January Populations: Average Percentages, 1955-58	Seasonal Population Changes in 1958-59 (Percentages)				
		Oct.2-10	Nov.3-12	Dec.1-12	Jan.7-12	Mar.3-16
Whistling Swan	6		1	2	9	4
Canada Goose	4		1	4	15	12
Mallard	2	6	+	+		1
Black Duck	6	87	2	3	3	2
Green-winged Teal						+
Blue-winged Teal						+
American Widgeon		7	2	1		+
Wood Duck		+				
Redhead	2			17		1
Ring-necked Duck			+	+		+
Canvasback	11		7	24	7	14
Scaup	4		5	9	1	11
Common Goldeneye and Bufflehead	+		+	1	8	1
Oldsquaw	+			+	+	
Scooters				+		+
Ruddy Duck	62		75	36	57	53
Mergansers	+					+
American Coot	1		6	2		+
Total Percent	100	100	100	100	100	100
Total Population	34,400	100	55,700	72,000	14,400	25,400

Table 25

## SPECIES COMPOSITION OF WATERFOWL POPULATIONS IN THE SUSQUEHANNA FLATS SECTION

	January Populations: Average Percentages, 1955-58	Seasonal Population Changes in 1958-59 (Percentages)				
		Oct.2-10	Nov.3-12	Dec.1-12	Jan.7-13	Mar.3-16
Whistling Swan	7			9	22	3
Canada Goose	5		1	17	24	3
Mallard	3	+		1	+	+
Black Duck	8	1	3	16	33	1
Pintail	+	+	+			+
Green-winged Teal		+				
American Widgeon	12	98	13	3		+
Redhead	31		6	25		58
Ring-necked Duck			3			
Canvasback	10		60	24	1	14
Scaup			6	+		18
Common Goldeneye and Bufflehead	2		1	5	19	2
Scoters	+					
Ruddy Duck			+			
Mergansers	1			+		+
American Coot	10	+	7		1	+
Unidentified Ducks	9					
Total Percent	100	100	100	100	100	100
Total Populations	28,400	13,600	56,700	14,800	3,500	76,900

Table 26

## SPECIES COMPOSITION OF WATERFOWL POPULATIONS IN THE UPPER EASTERN SHORE SECTION

	January Populations: Average Percentages, 1955-58	Seasonal Population Changes in 1958-59 (Percentages)				
		Oct.2-10	Nov.3-12	Dec.1-12	Jan.7-13	Mar.3-16
Whistling Swan	1			1	+	1
Canada Goose	51	76	52	65	92	74
Blue Goose	+					
Mallard	10	4	25	13	+	4
Black Duck	15	15	22	10	5	7
Pintail	2	4		5		2
Green-winged Teal		+	+			
Blue-winged Teal			+			
American Widgeon	6	1	+		2	2
Redhead	1					
Ring-necked Duck			+			3
Canvasback	10			+		7
Scaup	1			4		
Common Goldeneye and Bufflehead	+			1		+
Scoters	+					
Ruddy Duck	+			1		
Mergansers	+			+		+
American Coot	+		+	+		
Unidentified Ducks	2	+	+			
Total Percent	100	100	100	100	100	100
Total Populations	61,800	5,300	20,000	33,000	29,000	50,000

Table 27

## SPECIES COMPOSITION OF WATERFOWL POPULATIONS IN THE CHESTER RIVER SECTION

	January Populations: Average Percentages, 1955-58	Seasonal Population Changes in 1958-59 (Percentages)				
		Oct.2-10	Nov.3-12	Dec.1-12	Jan.7-13	Mar.3-16
Whistling Swan	5		+	4	3	6
Canada Goose	24	6	39	23	34	33
Snow Goose	+		+	+		
Blue Goose	+		+			
Mallard	15	6	10	14	17	18
Black Duck	23	13	16	22	25	11
Gadwall	+					
Pintail	6	12	7	10	3	10
Green-winged Teal			+			
Blue-winged Teal		+	+			
American Widgeon	8	61	16	4	5	9
Redhead	2		+	1	1	+
Ring-necked Duck	+	+	+	1	+	+
Canvasback	8		2	14	6	6
Scaup	1	+	2	4	4	3
Common Goldeneye and Bufflehead	+		+	+	2	2
Oldsquaw	+					
Scoters	1	2	1	+		
Ruddy Duck	1		+	1		+
Mergansers	+		+	+	+	+
American Coot	3	+	5	2	+	1
Unidentified Ducks	2	+	+			+
Total Percent	100	100	100	100	100	100
Total Population	200,800	20,100	109,000	208,700	156,800	74,500

Table 28

## SPECIES COMPOSITION OF WATERFOWL POPULATIONS IN THE EASTERN BAY SECTION

	January Populations: Average Percentages, 1955-58	Seasonal Population Changes in 1958-59 (Percentages)				
		Oct.2-10	Nov.3-12	Dec.1-12	Jan.7-13	Mar.3-16
Whistling Swan	4		+	12	4	11
Canada Goose	21	6	53	47	26	36
Mallard	5	2	1	8	9	1
Black Duck	15	44	23	17	15	7
Gadwall			+			
Pintail	4	2	1	1	1	1
Green-winged Teal		+	+			+
American Widgeon	9	37	16	6	1	5
Wood Duck			+			
Redhead	7				21	1
Ring-necked Duck	1		+	+		+
Canvasback	21			1	13	23
Scaup	3		+		5	7
Common Goldeneye and Bufflehead	3		1	5	4	7
Oldsquaw	+			+	+	
Scoters	1	8	1	+	+	+
Ruddy Duck	1		3	2		+
Mergansers	+			+	+	+
American Coot	3				+	+
Unidentified Ducks	+		+			
Total Percent	100	100	100	100	100	100
Total Populations	135,300	4,000	19,800	64,000	114,100	49,900

Table 29

## SPECIES COMPOSITION OF WATERFOWL POPULATIONS IN THE CHOPTANK RIVER SECTION

	January Populations: Average Percentages, 1955-58	Seasonal Population Changes in 1958-59 (Percentages)				
		Oct.2-10	Nov.3-12	Dec.1-12	Jan.7-12	Mar.3-16
Whistling Swan	7		+	9	7	7
Canada Goose	22	4	63	34	18	21
Brant	+					
Snow Goose	+				+	
Blue Goose	+					
Mallard	6	4	1	1	8	1
Black Duck	16	38	11	11	18	7
Gadwall				+		
Pintail	2	3	1	+	3	2
Green-winged Teal		+	+	+		+
Blue-winged Teal		+				
Shoveler						+
American Widgeon	5	49	15	5	3	7
Wood Duck			+	+		
Redhead	15			2	15	1
Ring-necked Duck					1	2
Canvasback	15			15	20	28
Scaup	1		+	11	2	13
Common Goldeneye and Bufflehead	3		1	3	4	8
Oldsquaw	+			+	+	+
Scoters	3	1	1	+	1	+
Ruddy Duck	+		5	8		2
Mergansers			+	+	+	+
American Coot	3			1	+	
Unidentified Ducks	2		+			
Total Percent	100	100	100	100	100	100
Total Populations	117,100	4,300	41,900	87,200	104,800	60,400



Table 30

## SPECIES COMPOSITION OF WATERFOWL POPULATIONS IN THE BLACKWATER-NANTICOKE SECTION

	January Populations: Average Percentages, 1955-58	Seasonal Population Changes in 1958-59 (Percentages)				
		Oct.2-10	Nov.3-12	Dec.1-12	Jan.7-13	Mar.3-16
Whistling Swan	+		+	+		+
Canada Goose	25	26	44	32	25	13
Snow Goose	+		+	+	+	
Blue Goose	+					
Mallard	25	5	4	12	39	2
Black Duck	13	27	11	26	32	8
Gadwall	+			+		+
Pintail	9	6	5	+		+
Green-winged Teal	+	10	2	3	+	1
Blue-winged Teal		+				+
Shoveler						+
American Widgeon	2	25	30	+		+
Wood Duck			+	+		+
Redhead	6			+		29
Ring-necked Duck	+		+	1	+	
Canvasback	12			19	1	18
Scaup	2			5		26
Common Goldeneye and Bufflehead	1		+	1	2	+
Oldsquaw			+		+	+
Scoters	+			+		
Ruddy Duck	3		1	+	1	1
Mergansers	+			+	+	+
American Coot	+				+	
Unidentified Ducks		+	+			
Total Percent	100	100	100	100	100	100
Total Populations	126,500	7,000	37,700	25,800	16,000	25,900

Table 31

## SPECIES COMPOSITION OF WATERFOWL POPULATIONS IN THE LOWER EASTERN SHORE SECTION

	January Populations: Average Percentages, 1955-58	Seasonal Population Changes in 1958-59 (Percentages)				
		Oct.2-10	Nov.3-12	Dec.1-12	Jan.7-13	Mar.3-16
Whistling Swan	4		+	1	2	4
Canada Goose	27	+	22	17	24	6
Brant	+		+	+	+	
Mallard	4	1	1	+	1	+
Black Duck	17	48	24	19	27	14
Gadwall			+	1	+	+
Pintail	16	3	18	8	8	+
Green-winged Teal	+	2	2	1	+	1
Blue-winged Teal		+	+			+
Shoveler				+		+
American Widgeon	6	45	27	6	1	3
Wood Duck			+	+		+
Redhead	11			1	21	10
Ring-necked Duck					+	5
Canvasback	5			9	3	10
Scaup	3			17	3	32
Common Goldeneye and Bufflehead	3		4	10	8	11
Oldsquaw	+		+	+	+	+
Scoters	1		1	2	+	1
Ruddy Duck	1		+	+	+	+
Mergansers	+					
American Coot	1		+			
Unidentified Ducks		1	+			
Total Percent	100	100	100	100	100	100
Total Populations	63,600	4,100	16,500	45,900	41,200	20,200

Table 32

## SPECIES COMPOSITION OF WATERFOWL POPULATIONS IN THE COASTAL SECTION

	January Populations: Average Percentages, 1955-58	Seasonal Population Changes in 1958-59 (Percentages)				
		Oct.2-10	Nov.3-12	Dec.1-12	Jan.7-13	Mar.3-16
Whistling Swan	+			+		+
Canada Goose	11		21	10	5	10
Brant	12			4	6	21
Snow Goose	5			+	+	+
Mallard	6	14	2	1	4	2
Black Duck	22	26	20	41	31	23
Gadwall				3	+	
Pintail	1	6	12	9	1	1
Green-winged Teal	+	4	8	2		4
Blue-winged Teal		13	1	+		2
Shoveler				3		2
American Widgeon	+	36	33	10	1	13
Redhead	4					
Ring-necked Duck	+			+	+	+
Canvasback	15			9	26	18
Scaup	11			1	23	+
Common Goldeneye and Bufflehead	4		+	2	3	4
Oldsquaw				+		+
Scoters	6		+	+	+	+
Mergansers	+					
American Coot	+		3	2		
Unidentified Ducks	1	+				
Total Percent	100	100	100	100	100	100
Total Populations	44,000	5,200	33,900	41,200	33,700	16,400

Table 33

## ECOLOGICAL DISTRIBUTION OF WHISTLING SWANS DURING THE 1958-59 SEASON

	Nov. 3-12, 1958	Dec. 1-12, 1958	Jan. 7-13, 1959	Mar. 3-16, 1959
Fresh Estuarine Bays	57%	8%	7%	17%
Slightly Brackish Estuarine Bays	29%	9%	8%	6%
Brackish Estuarine Bays	8%	81%	79%	71%
Salt Estuarine Bays	3%	2%	6%	5%
Fresh and Brackish- Estuarine Bay Marshes	3%	+	0	1%
Coastal Impoundment and Bay Complex	0	+	0	+
Total Populations	600	34,900	23,700	22,200

Table 34

## BIOGEOGRAPHICAL DISTRIBUTION OF WHISTLING SWANS DURING WINTERS OF 1955-58

Chester River Section	27%	Central Potomac Section	3%
Choptank River Section	22%	Patuxent River Section	1%
Eastern Bay Section	14%	Upper Eastern Shore Section	1%
Central Western Shore Section	9%	Coastal Section	1%
Lower Eastern Shore Section	8%	Upper Potomac Section	+
Upper Western Shore Section	6%	Lower Western Shore Section	+
Susquehanna Flats Section	5%	Blackwater-Nanticoke Section	+
Lower Potomac Section	4%		
		Total	100%

Table 35

## BIOGEOGRAPHICAL DISTRIBUTION OF WHISTLING SWANS DURING THE 1958-59 SEASON

	Nov.3-12, 1958	Dec.1-12, 1958	Jan.7-13, 1959	Mar.3-16, 1959
Choptank River Section	<u>+</u>	<u>22%</u>	<u>29%</u>	<u>19%</u>
Lower Choptank	(0)	(14)	(17)	(7)
Central Choptank	(+)	( 6)	( 7)	(7)
Little Choptank	(0)	( 2)	( 5)	(5)
Eastern Bay Section	<u>+</u>	<u>22</u>	<u>20</u>	<u>26</u>
Upper Eastern Bay	(+)	(12)	(11)	(14)
Miles River	(0)	( 6)	( 7)	(6)
Chester River Section	<u>5</u>	<u>27</u>	<u>17</u>	<u>19</u>
Central Chester River	(0)	(17)	(11)	(8)
Lower Chester River	(5)	(10)	( 6)	(11)
Susquehanna Flats Section	<u>0</u>	<u>4</u>	<u>3</u>	<u>12</u>
Central Western Shore Section	<u>0</u>	<u>6</u>	<u>8</u>	<u>3</u>
Upper Western Shore Section	<u>57</u>	<u>5</u>	<u>5</u>	<u>5</u>
Central Potomac Section	<u>28</u>	<u>6</u>	<u>6</u>	<u>2</u>
Patuxent River Section	<u>2</u>	<u>3</u>	<u>3</u>	<u>3</u>
Lower Eastern Shore Section	<u>3</u>	<u>2</u>	<u>4</u>	<u>4</u>
Lower Potomac Section	<u>0</u>	<u>1</u>	<u>3</u>	<u>3</u>
Upper Eastern Shore Section	<u>0</u>	<u>1</u>	<u>+</u>	<u>3</u>
Upper Potomac Section	<u>0</u>	<u>0</u>	<u>+</u>	<u>2</u>
Blackwater-Nanticoke Section	<u>3</u>	<u>+</u>	<u>0</u>	<u>1</u>
Coastal Section	<u>0</u>	<u>+</u>	<u>0</u>	<u>+</u>
Lower Western-Shore Section	<u>0</u>	<u>0</u>	<u>+</u>	<u>+</u>
Total Population	600	34,900	23,700	22,200

Table 36

FOODS OF WHISTLING SWANS FROM THE UPPER CHESAPEAKE REGION<sup>1</sup>

	Fresh Estuarine Bays, 4 Birds <sup>2</sup>	Brackish Estuarine Bays, 42 Birds <sup>3</sup>	Fresh and Brackish Estuarine Bay Marsh, 4 Birds <sup>4</sup>
Leaves, Stems, Rootstalks,			
Tubers, Shoots and Buds			
of Submerged Aquatic Plants	<u>100%(39-100)</u>	<u>71%(55-85)</u>	<u>50%(6-94)</u>
Wildcelery	100%(39-100)		
Widgeongrass		69%(52-83)	50%(6-94)
Sago Pondweed		21%(10-37)	
Claspingleaf Pondweed	25%(+ -81)	5%(+ -17)	
Enteromorpha		2%(+ -13)	
Bivalve Mollusks (Pelecypoda)		<u>55%(38-71)</u>	
<u>Mya arenaria</u>		26%(13-43)	
<u>Macoma balthica</u>		31%(17-48)	
<u>Macoma phenax</u>		2%(+ -13)	
<u>Tagelus plebius</u>		2%(+ -13)	
Undetermined		2%(+ -13)	
Rootstalks and Stems of			
Emergent Marsh Plants		<u>2%(+ -13)</u>	<u>75%(19-100)</u>
Three-square			25%(+ -81)
Grass (probably Saltgrass)			25%(+ -81)
Undetermined		2%(+ -13)	25%(+ -81)

Table 36--(continued)

	Fresh Estuarine Bays, 4 Birds <sup>2</sup>	Brackish Estuarine Bays, 42 Birds <sup>3</sup>	Fresh and Brackish Estuarine Bay Marsh, 4 Birds <sup>4</sup>
Miscellaneous Foods		<u>12%(3-26)</u>	<u>25%(+ -81)</u>
Corn (Illegal Bait)		10%(2-23)	
Galls on Muskgrass			25%(+ -81)
Blackgum-seeds		2%(+ -13)	

<sup>1</sup> Percentage occurrence of foods that made up 5% or more of the volume in individual birds. Figures in parentheses show 95% confidence limits.

<sup>2</sup> Two from Susquehanna Flats, March 10, 1911; 1 from Gunpowder River, March 2, 1927; 1 from Upper Potomac estuary near Marshall Hall, Nov. 16, 1900.

<sup>3</sup> Thirty-three from Chester River near Pioneer Point, Queen Annes County, Jan. 17-March 5, 1955; 7 from upper portion of Miles River, Talbot County, Dec. 16-20, 1954; 1 from Choptank River Area, Dorchester County, Nov. 15, 1955.

<sup>4</sup> From Dorchester County, Jan. 8, 1955 and March 21, 1956.

Table 37

## BIOGEOGRAPHICAL DISTRIBUTION OF CANADA GEESE DURING WINTERS OF 1955-58

Chester River Section	25%	Upper Western Shore Section	1%
Upper Eastern Shore Section	16%	Lower Potomac Section	1%
Blackwater-Nanticoke Section	16%	Central Potomac Section	+%
Eastern Bay Section	15%	Patuxent River Section	+%
Choptank River Section	13%	Upper Potomac Section	+%
Lower Eastern Shore Section	9%	Central Western Shore Section	0
Coastal Section	3%	Lower Western Shore Section	0
Susquehanna Flats Section	1%	Total	100%

Table 38

## BIOGEOGRAPHICAL DISTRIBUTION OF CANADA GEESE DURING THE 1958-59 SEASON

	Oct.2-10, 1958	Nov.3-12, 1958	Dec.1-12, 1958	Jan.7-13, 1959	Mar.3-16, 1959
Chester River Section	<u>17%</u>	<u>35%</u>	<u>31%</u>	<u>35%</u>	<u>24%</u>
Central Chester River	(14)	(34)	(28)	(30)	(18)
Eastern Bay Section	<u>3%</u>	<u>9%</u>	<u>19%</u>	<u>20%</u>	<u>17%</u>
Upper Eastern Bay	( 1)	( 3)	( 9)	( 8)	( 8)
Wye River	( 3)	( 4)	( 4)	( 6)	( 7)
Miles River	( 0)	( 1)	( 5)	( 6)	( 1)
Choptank River Section	<u>2%</u>	<u>22%</u>	<u>19%</u>	<u>13%</u>	<u>12%</u>
Lower Choptank	( 2)	(11)	(12)	( 8)	( 9)
Central Choptank	( 0)	( 9)	( 6)	( 5)	( 2)
Upper Eastern Shore Section	<u>51%</u>	<u>9%</u>	<u>13%</u>	<u>18%</u>	<u>35%</u>
Sassafras River	(47)	( 7)	(13)	(14)	(30)
Chesapeake Shore	( 3)	( 2)	( +)	( 3)	( 5)
Blackwater-Nanticoke Section	<u>23%</u>	<u>14%</u>	<u>5%</u>	<u>3%</u>	<u>3%</u>
Upper Blackwater	(22)	( 8)	( 4)	( 2)	( 3)
Lower Blackwater-Nanticoke	( 2)	( 5)	( 1)	( +)	( 1)
Lower Eastern Shore Section	<u>+</u>	<u>3%</u>	<u>5%</u>	<u>7%</u>	<u>1%</u>
Coastal Section	<u>0</u>	<u>6%</u>	<u>3%</u>	<u>1%</u>	<u>1%</u>
Newport Bay	( 0)	( 5)	( 2)	( +)	( 1)
Upper Western Shore Section	<u>0</u>	<u>+</u>	<u>2%</u>	<u>1%</u>	<u>3%</u>
Susquehanna Flats Section	<u>0</u>	<u>1%</u>	<u>2%</u>	<u>1%</u>	<u>2%</u>
Central Potomac Section	<u>+</u>	<u>1%</u>	<u>1%</u>	<u>1%</u>	<u>+</u>
Lower Potomac Section	<u>3%</u>	<u>1%</u>	<u>1%</u>	<u>1%</u>	<u>+</u>
Central Western Shore Section	<u>0</u>	<u>0</u>	<u>+</u>	<u>+</u>	<u>0</u>
Upper Potomac Section	<u>0</u>	<u>+</u>	<u>0</u>	<u>+</u>	<u>0</u>
Patuxent River Section	<u>+</u>	<u>0</u>	<u>+</u>	<u>0</u>	<u>+</u>
Lower Western Shore Section	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
Total Population	7,900	119,800	158,700	148,300	103,900



Table 39

FOODS OF CANADA GEESE FROM THE UPPER CHESAPEAKE REGION<sup>1</sup>

	Fresh Estuarine Bays With Large Adjacent Agricultural Fields 5 Birds <sup>2</sup>	Fresh and Brackish Bay Marshes 10 Birds <sup>3</sup>
Rootstalks and Stems of Emergent Marsh Plants		<u>70%(34-94)</u>
Three-square(including <u>Scirpus americanus</u> and <u>S. olneyi</u> )		60%(26-88)
Saltgrass		20%( 2-56)
Saltmarsh Cordgrass		10%( +-45)
Leaves, Stems and Rootstalks of Submerged Aquatic Plants	<u>20%( +-72)</u>	<u>30%( 6-66)</u>
Widgeongrass		30%( 6-66)
Wildcelery	20%( +-72)	
Claspingleaf Pondweed	20%( +-72)	
Grain	<u>100%(47-100)</u>	<u>10%( +-45)</u>
Corn	100%(47-100)	10%( +-45)
Wheat		10%( +-45)
Small Seeds		<u>30%( 6-66)</u>
Common Three-square		20%( 2-56)
Twigrush		10%( +-45)
Blackgum		10%( +-45)

<sup>1</sup> Percentage occurrence of foods that made up 5% or more of the volume in individual birds. Figures in parentheses show 95% confidence limits.

<sup>2</sup> Sassafras River: 4 on Jan. 26, 1950, 1 on Sept. 26, 1957.

<sup>3</sup> Dorchester County, Nov. 8-Dec. 31, 1942-57.

Table 40

LOCAL DISTRIBUTION OF HUNTING KILL OF CANADA GEESE<sup>1</sup>

Chester River Section	25%	Lower Potomac Section	2%
Choptank River Section	24%	Central Potomac Section	2%
Lower Eastern Shore Section	18%	Upper Western Shore Section	+
Upper Eastern Shore Section	16%	Susquehanna Flats Section	+
Eastern Bay Section	7%	Other Sections	0
Blackwater-Nanticoke Section	5%	Total	100%

<sup>1</sup> Based on 133 weighted band recoveries.

Table 41

## HARVEST AREAS OF CANADA GEESE BANDED AT BLACKWATER NATIONAL WILDLIFE REFUGE

Area of Recovery	Distribution of Indirect Recoveries			
	43 Recoveries, Fall-banded (Nov.22-Dec.20 1951-55)	41 Recoveries, Winter-banded (Dec.22-Feb.20 1952-58)	21 Recoveries, Spring-banded (Mar.1-March 30 1952-57)	Total 105 Recoveries, Banded 1951-58
East-Central Canada	<u>47%</u>	<u>17%</u>	<u>19%</u>	<u>30%</u>
Quebec	37	15	10	23
Ontario	9	2	5	6
Keewatin			5	1
Eastern Canada		<u>2%</u>	<u>5%</u>	<u>2%</u>
New Brunswick			5	1
Prince Edward Island		2		1
Eastern Great-Lakes States	<u>2%</u>	<u>7%</u>	<u>10%</u>	<u>6%</u>
Michigan	2			1
New York		7	10	5
Mid-Atlantic States	<u>51%</u>	<u>71%</u>	<u>67%</u>	<u>62%</u>
New Jersey		2		1
Delaware		5		2
Maryland	37	37	52	40
Virginia	7	10		7
North Carolina	7	17	14	12
Southeastern States		<u>2%</u>		<u>1%</u>
Alabama		2		1
TOTAL	100%	100%	100%	100%

Table 42

## BIOGEOGRAPHICAL DISTRIBUTION OF BRANT DURING THE 1958-59 SEASON

	Nov.3-12, 1958	Dec.1-12, 1958	Jan.7-13, 1959	Mar.3-16, 1959
Coastal Section	<u>0</u>	<u>95%</u>	<u>94%</u>	<u>100%</u>
Sinepuxent Bay	(0)	(83)	(63)	(32)
Chincoteague Bay	(0)	(12)	( 0)	(50)
Assawoman Bay	(0)	( 0)	(31)	(18)
Lower Eastern Shore Section	<u>100%</u>	<u>5%</u>	<u>6%</u>	<u>0</u>
Smith Island Area	(29)	( 5)	( 6)	( 0)
Tar Bay Area	(71)	( 0)	( 0)	( 0)
Other Sections	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
Total Populations	70	1,900	2,100	3,400

Table 43

FOODS OF BRANT FROM THE UPPER CHESAPEAKE REGION<sup>1</sup>

	Coastal Bays 5 Birds <sup>2</sup>	Washington Market 8 Birds <sup>3</sup>
Stems and Leaves (or Thalli) of Submerged Aquatic Plants	<u>100% (47-100)</u>	<u>100% (63-100)</u>
Sea-lettuce	100% (47-100)	
Eelgrass		100% (63-100)
Widgeongrass		100% (63-100)

<sup>1</sup> Percentage occurrence of foods that made up 5% or more of the volume in individual birds. Figures in parentheses show 95% confidence limits.

<sup>2</sup> Sinepuxent and Isle of Wight Bays, Worcester County, Maryland, March 7 and March 22, 1956.

<sup>3</sup> Purchased in Washington, D. C. market, December, 1913, probably shot along eastern shore of Chesapeake Bay.

Table 44

## ECOLOGICAL DISTRIBUTION OF MALLARDS DURING THE 1958-59 SEASON

	Oct.2-10, 1958	Nov.3-12, 1958	Dec.1-12, 1958	Jan.7-13, 1959	Mar.3-16, 1959
Shallow Estuaries with Extensive Adjacent Agricultural Lands	<u>50%</u>	<u>73%</u>	<u>85%</u>	<u>82%</u>	<u>86%</u>
Brackish Estuaries	(42)	(51)	(76)	(82)	(76)
Fresh and Slightly Brackish Estuaries	( 8)	(22)	( 9)	( +)	(10)
Estuarine River Marshes	<u>6%</u>	<u>14%</u>	<u>5%</u>	<u>1%</u>	<u>9%</u>
Estuarine Bay Marshes	<u>11%</u>	<u>4%</u>	<u>5%</u>	<u>12%</u>	<u>1%</u>
Fresh Bay Marshes	( 7)	( 3)	( 5)	(11)	( +)
Brackish Bay Marshes	( 3)	( +)	( +)	( +)	( +)
Salt Bay Marshes	( 1)	( 1)	( +)	( 1)	( 1)
Coastal Salt Marshes and Adjacent Impoundments	<u>24%</u>	<u>3%</u>	<u>1%</u>	<u>2%</u>	<u>2%</u>
Miscellaneous Habitat Mixtures	<u>9%</u>	<u>6%</u>	<u>4%</u>	<u>3%</u>	<u>2%</u>
Total Populations	3,000	23,000	48,200	55,800	18,300

Table 45

## BIOGEOGRAPHICAL DISTRIBUTION OF MALLARDS DURING WINTERS OF 1955-58

Blackwater-Nanticoke Section	35%	Upper Potomac Section	1%
Chester River Section	32%	Patuxent River Section	1%
Eastern Bay Section	8%	Susquehanna Flats Section	1%
Choptank River Section	7%	Upper Western Shore Section	1%
Upper Eastern Shore Section	7%	Lower Potomac Section	+
Coastal Section	3%	Central Western Shore Section	+
Lower Eastern Shore Section	3%	Lower Western Shore Section	0
Central Potomac Section	1%	Total	100%

Table 46

## BIOGEOGRAPHICAL DISTRIBUTION OF MALLARDS DURING THE 1958-59 SEASON

	Oct.2-10, 1958	Nov.3-12, 1958	Dec.1-12, 1958	Jan.7-13, 1959	Mar.3-16, 1959
Chester River Section	<u>38%</u>	<u>49%</u>	<u>62%</u>	<u>49%</u>	<u>73%</u>
Central Chester River	(36)	(48)	(59)	(31)	( 9)
Upper Chester River	( + )	( + )	( + )	(18)	(62)
Eastern Bay Section	<u>2%</u>	<u>1%</u>	<u>11%</u>	<u>18%</u>	<u>2%</u>
Upper Eastern Bay	( 1 )	( + )	( 9 )	( 7 )	( 0 )
Miles River	( 1 )	( + )	( + )	( 7 )	( + )
Blackwater-Nanticoke Section	<u>11%</u>	<u>7%</u>	<u>6%</u>	<u>11%</u>	<u>3%</u>
Upper Blackwater	( 7 )	( 3 )	( 5 )	(11)	( + )
Upper Eastern Shore Section	<u>7%</u>	<u>22%</u>	<u>9%</u>	<u>+</u>	<u>10%</u>
Bay Shore	( 6 )	(21)	( 1 )	( + )	( 4 )
Sassafras River	( + )	( + )	( 9 )	( + )	( 3 )
Choptank River Section	<u>5%</u>	<u>2%</u>	<u>2%</u>	<u>15%</u>	<u>3%</u>
Central Choptank	( 1 )	( 1 )	( 1 )	(10)	( + )
Patuxent River Section	<u>6%</u>	<u>9%</u>	<u>4%</u>	<u>1%</u>	<u>5%</u>
Patuxent Marsh	( 3 )	( 9 )	( 4 )	( 1 )	( 5 )
Coastal Section	<u>24%</u>	<u>3%</u>	<u>1%</u>	<u>2%</u>	<u>2%</u>
Central Potomac Section	<u>1%</u>	<u>5%</u>	<u>2%</u>	<u>1%</u>	<u>1%</u>
Lower Potomac Section	<u>0</u>	<u>+</u>	<u>1%</u>	<u>1%</u>	<u>1%</u>
Lower Eastern Shore Section	<u>1%</u>	<u>1%</u>	<u>+</u>	<u>1%</u>	<u>1%</u>
Susquehanna Flats Section	<u>1%</u>	<u>0</u>	<u>+</u>	<u>+</u>	<u>+</u>
Upper Western Shore Section	<u>+</u>	<u>+</u>	<u>+</u>	<u>0</u>	<u>1%</u>
Upper Potomac Section	<u>+</u>	<u>+</u>	<u>+</u>	<u>+</u>	<u>+</u>
Central Western Shore Section	<u>3%</u>	<u>+</u>	<u>+</u>	<u>+</u>	<u>0</u>
Lower Western Shore Section	<u>0</u>	<u>0</u>	<u>0</u>	<u>+</u>	<u>+</u>
Total Populations	3,000	23,000	48,200	55,800	18,300

Table 47

FOODS OF 13 MALLARDS FROM BRACKISH ESTUARINE BAYS ADJOINING AGRICULTURAL FIELDS<sup>1</sup>

Seeds	69% (38-91)	Grain	46% (19-75)
Widgeongrass	46 (19-75)	Corn	38 (13-69)
Claspingleaf Pondweed	31 (9-62)	Wheat	8 (+-37)
Dotted Smartweed	15 (1-46)	Leaves, Stems and Rootstalks of Submerged Aquatic Plants	38 (13-69)
Smartweed	8 (+-37)	Claspingleaf Pondweed	23 (5-54)
Largeseed Smartweed	8 (+-37)	Widgeongrass	8 (+-37)
Olney Three-square	8 (+-37)	Wildcelery	8 (+-37)
Hightide-bush	8 (+-37)	Eelgrass	8 (+-37)
Swamp Rose	8 (+-37)	Mollusks	8 (+-37)
Holly	8 (+-37)	<u>Macoma balthica</u> (Pelecypoda)	8 (+-37)

<sup>1</sup> Seven from Chester River and Eastern Bay sections, 4 from Choptank River section, 1 from Susquehanna Flats section, 1 from upper western shore section; all collected during fall and winter. Percentage occurrence of foods that made up 5% or more of the volume in individual birds. Figures in parentheses show 95% confidence limits.

Table 48

FOODS OF 12 MALLARDS FROM ESTUARINE RIVER MARSHES<sup>1</sup>

Seeds	100% (73-100)	Seeds (con't.)	
Dotted Smartweed	58 (27-84)	Walter Millet	8% (+-39)
Softstem Bulrush	42 (15-73)	Swamp Dock	8 (+-39)
Common Three-square	42 (15-73)	Grassleaf Pondweed	8 (+-39)
Halberdleaf Tearthumb	33 (9-66)	Big Cordgrass	8 (+-39)
Arrow-arum	25 (5-58)	Sedge ( <u>Carex lurida</u> )	8 (+-39)
Common Burreed	17 (2-49)	Blackgum	8 (+-39)
Giant Burreed	17 (2-49)	Rootstalks of Emergent Marsh Plants	25 (5-58)
Waxmyrtle	17 (2-49)	Bulrush	17 (2-49)
Grape	17 (2-49)	Undetermined Species	8 (+-39)
Olney Three-square	8 (+-39)		
Saltmarsh Bulrush	8 (+-39)		

<sup>1</sup> Eleven from Patuxent River marsh, 1 from Elk River marsh; collected during early fall and spring. Percentage occurrence of foods that made up 5% or more of the volume in individual birds. Figures in parentheses show 95% confidence limits.

Table 49

FOODS OF 28 MALLARDS FROM ESTUARINE BAY MARSHES<sup>1</sup>

Small seeds	68% (47-85)	Leaves, Stems and Rootstalks of Submerged Aquatic Plants (Cont.)	
Olney Three-square	29 (13-49)	Sago Pondweed	4 ( +-19)
Widgeongrass	25 (10-45)	Pondweed	4 ( +-19)
Twigrush	25 (10-45)	Grain	25% (10-45)
Saltgrass	14 ( 4-33)	Corn	25 (10-45)
Saltmarsh Cordgrass	14 ( 4-33)	Rootstalks of Emergent Herbaceous Marsh Plants	7 ( +-24)
Saltmarsh Bulrush	7 ( +-24)	Undetermined Species	7 ( +-24)
Hightide-bush	7 ( +-24)	Animal Food	25 (10-45)
Softstem Bulrush	7 ( +-24)	<u>Volselfa demissa</u> (Pelecypoda)	11 ( 2-29)
Dotted Smartweed	4 ( +-19)	<u>Molgula</u> sp. (Tunicata)	4 ( +-19)
Common Burreed	4 ( +-19)	Decapoda	4 ( +-19)
Sago Pondweed	4 ( +-19)	Amphipoda	4 ( +-19)
Largeseed Smartweed	4 ( +-19)	<u>Chiridotea coeca</u> (Isopoda)	4 ( +-19)
Leaves, Stems and Rootstalks of Submerged Aquatic Plants	32% (15-53)	Fish	4 ( +-19)
Widgeongrass	21 ( 8-41)		
Muskgrass	11 ( 2-29)		

<sup>1</sup> Twenty-one from brackish marshes and 5 from fresh marshes in Blackwater-Nanticoke section; 2 from salt estuarine bay marshes in lower eastern shore section; collected during late fall and winter.

Table 50

FOODS OF 17 MALLARDS FROM PATUXENT RIVER BOTTOMLANDS<sup>1</sup>

Mast	100% (80-100)	Seeds (con't.)	
Beech	76 (50-94)	Grape	6% ( +-29)
White Oak	24 ( 6-50)	Sweetbay	6 ( +-29)
Oak	6 ( +-29)	Leaves, Stems and Rootstalks of Submerged Aquatic Plants	18 ( 3-44)
Seeds	59 (32-82)	Nitella	18 ( 3-44)
Hornbeam	47 (22-73)	Animal Food	24 ( 6-50)
Sweetgum	12 ( 1-37)	<u>Physa</u> sp. (Gastropoda)	12 ( 1-37)
Poison-ivy	6 ( +-29)	Libelluloidea Nymphs	6 ( +-29)

<sup>1</sup> Vicinity of Patuxent Wildlife Research Center; collected during fall and early winter.

Percentage occurrence of foods that made up 5% or more of the volume in individual birds. Figures in parentheses show 95% confidence limits.



Table 51

FOODS OF 14 MALLARDS FROM INTERIOR DRAW-DOWN IMPOUNDMENTS<sup>1</sup>

Seeds	100% (76-100)	Seeds (con't)	
Common Burreed	93 (66-100)	Spatterdock	7% ( +-34)
Weak Bulrush	29 ( 8- 59)	Mermaidweed	7 ( +-34)
Buttonbush	29 ( 8- 59)	Arrowleaf Tearthumb	7 ( +-34)
Sedge ( <u>Carex lurida</u> )	29 ( 8- 59)	Berchtold Pondweed	7 ( +-34)
Dotted Smartweed	21 ( 4- 51)	Sedge ( <u>Carex folliculata</u> )	7 ( +-34)
Rice Cutgrass	21 ( 4- 51)	Poison-ivy	7 ( +-34)
Wild Millet	14 ( 1- 43)	Greenbrier	7 ( +-34)
Halberdleaf Tearthumb	14 ( 1- 43)	Blackgum	7 ( +-34)
Largeseed Smartweed	14 ( 1- 43)	Smartweed	7 ( +-34)
Redroot Cyperus	14 ( 1- 43)	Grain	<u>7</u> ( +-34)
Sedge ( <u>Carex intumescens</u> )	14 ( 1- 43)	Corn	7 ( +-34)
Sedge ( <u>Carex crinita</u> )	14 ( 1- 43)	Animal Food	<u>14</u> ( 1-43)
Panicum (Panicum agrostoides)	14 ( 1 -43)	Coleoptera larvae	7 ( +-34)
Swamp Rose	14 ( 1 -43)	Trichoptera larvae	7 ( +-34)
Sweetgum	14 ( 1 -43)	Libelluloidea nymphs	7 ( +-34)

<sup>1</sup> Patuxent Wildlife Research Center. All collected during fall and early winter. Percentage occurrence of foods that made up 5% or more of the volume in individual birds. Figures in parentheses show 95% confidence limits.

Table 52

LOCAL DISTRIBUTION OF HUNTING KILL OF WILD MALLARDS<sup>1</sup>

Chester River Section	24%	Upper Western Shore Section	3%
Coastal Section	13	Central Potomac Section	3
Choptank River Section	12	Upper Potomac Section	2
Eastern Bay Section	11	Coastal Plain Interior	2
Blackwater-Nanticoke Section	9	Patuxent River Section	2
Lower Eastern Shore Section	9	Lower Potomac Section	2
Upper Eastern Shore Section	6	Lower Western Shore Section	+
Susquehanna Flats Section	3	Central Western Shore Section	+
	Total		100%

<sup>1</sup> Based on 244 weighted band recoveries.

Table 53

HARVEST AREAS OF WILD MALLARDS Banded IN DORCHESTER COUNTY MARSHES  
AND IN CHESTER RIVER-EASTERN BAY AREA

<u>Areas of Recovery</u>	<u>Distribution of Indirect Recoveries</u>			
	33 Recoveries, Fall-banded (Aug. 25-Dec. 19 1950-57)	90 Recoveries, Winter-banded (Dec. 31-Feb. 26 1950-58)	47 Recoveries, Spring-banded (Feb. 22-Apr. 1 1953-58)	Total Recoveries, Banded 1950-58
Mid-Atlantic States	<u>52%</u>	<u>51%</u>	<u>40%</u>	<u>48%</u>
New Jersey	3	8	2	5
Pennsylvania	3	4		3
Delaware	3	7	2	5
Maryland	36	24	26	27
Virginia	3	4	4	4
North Carolina	3	3	6	4
Eastern Great Lakes Area	<u>9%</u>	<u>6%</u>	<u>23%</u>	<u>11%</u>
New York	3	2	9	4
Michigan	6	1	6	4
Ohio		2	9	4
North-Central States	<u>3%</u>	<u>14%</u>	<u>9%</u>	<u>12%</u>
Wisconsin	3	7	2	5
Minnesota		4	4	4
North Dakota		1	2	1
South Dakota		2		1
East-Central Canada	<u>24%</u>	<u>9%</u>	<u>11%</u>	<u>12%</u>
Quebec	3		2	1
Ontario	21	9	9	11
Prairie Provinces	<u>9%</u>	<u>14%</u>	<u>4%</u>	<u>11%</u>
Manitoba	3	8		5
Saskatchewan	6	3	4	4
Alberta		3		2
Southeastern States (S.C.)	<u>2%</u>	<u>2%</u>	<u>2%</u>	<u>2%</u>
Other (Ark., Ill., Ind., Ia., Ky., Mass., Tenn., W.Va.)	<u>3%</u>	<u>3%</u>	<u>11%</u>	<u>5%</u>
Total	100%	100%	100%	100%

Table 54

## ECOLOGICAL DISTRIBUTION OF BLACK DUCKS DURING THE 1958-59 SEASON

	Oct.2-10, 1958	Nov.3-12, 1958	Dec.1-12, 1958	Jan.7-13, 1959	Mar.3-16, 1959
Shallow Estuarine Bays with Extensive Adjacent Agricultural Lands	<u>50%</u>	<u>59%</u>	<u>62%</u>	<u>69%</u>	<u>61%</u>
Brackish Estuaries	(44)	(51)	(59)	(68)	(50)
Fresh and Slightly Brackish Estuaries	( 6)	( 8)	( 3)	( 1)	(11)
Estuarine Bay Marshes	<u>26%</u>	<u>13%</u>	<u>11%</u>	<u>11%</u>	<u>13%</u>
Salt Bay Marshes	(15)	( 8)	( 8)	(10)	( 9)
Fresh Bay Marshes	( 6)	( 3)	( 3)	( 2)	( 1)
Brackish Bay Marshes	( 5)	( 2)	(3)	( 2)	( 3)
Coastal Salt Marshes and Adjacent Impoundments	<u>10%</u>	<u>13%</u>	<u>15%</u>	<u>10%</u>	<u>11%</u>
Estuarine River Marshes	<u>10%</u>	<u>6%</u>	<u>2%</u>	<u>2%</u>	<u>5%</u>
Miscellaneous Habitat Mixtures	<u>4%</u>	<u>9%</u>	<u>7%</u>	<u>5%</u>	<u>10%</u>
Total Populations	12,900	51,500	111,700	108,800	32,300

Table 55

## BIOGEOGRAPHICAL DISTRIBUTION OF BLACK DUCKS DURING THE WINTERS OF 1955-58

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Chester River Section	32%
Eastern Bay Section	15
Choptank River Section	13
Blackwater-Nanticoke Section	11
Lower Eastern Shore Section	8
Coastal Section	7
Upper Eastern Shore Section	6
Central Potomac Section	2
Susquehanna Flats Section	2
Upper Western Shore Section	2
Patuxent River Section	1
Upper Potomac Section	1
Lower Potomac Section	+
Central Western Shore Section	+
Lower Western Shore Section	+
Total	100%

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Table 56

## BIOGEOGRAPHICAL DISTRIBUTION OF BLACK DUCKS DURING THE 1958-59 SEASON

	Oct.2-10, 1958	Nov.3-12, 1958	Dec.1-12, 1958	Jan.7-13, 1959	Mar.3-16, 1959
Chester River Section	<u>20%</u>	<u>34%</u>	<u>41%</u>	<u>36%</u>	<u>27%</u>
Central Chester River	(12)	(21)	(36)	(31)	(12)
Lower Chester River	( 8)	(13)	( 5)	( 3)	( 5)
Upper Chester River	( 1)	( +)	( +)	( 2)	( 9)
Coastal Section	<u>10%</u>	<u>13%</u>	<u>15%</u>	<u>10%</u>	<u>11%</u>
Outer Chincoteague Bay	( 8)	(11)	(13)	( 7)	( 6)
Choptank River Section	<u>13%</u>	<u>9%</u>	<u>8%</u>	<u>17%</u>	<u>13%</u>
Central Choptank	( 3)	( 5)	( 6)	( 8)	( 2)
Lower Choptank	( 5)	( 3)	( 2)	( 8)	( 9)
Eastern Bay Section	<u>14%</u>	<u>9%</u>	<u>10%</u>	<u>15%</u>	<u>11%</u>
Upper Eastern Bay	(10)	( 5)	( 6)	( 8)	( 5)
Miles River	( 1)	( 1)	( 2)	( 5)	( 2)
Lower Eastern Shore Section	<u>15%</u>	<u>8%</u>	<u>8%</u>	<u>10%</u>	<u>9%</u>
Hooper Island-Elliott Area	( 7)	( 4)	( 5)	( 5)	( 4)
Wicomico-Pocomoke Area	( 6)	( 2)	( 2)	( 3)	( 3)
Blackwater-Nanticoke Section	<u>15%</u>	<u>8%</u>	<u>6%</u>	<u>5%</u>	<u>7%</u>
Upper Blackwater	( 6)	( 3)	( 3)	( 2)	( 1)
Lower Blackwater-Nanticoke	( 5)	( 2)	( 3)	( 2)	( 3)
Upper Eastern Shore Section	<u>6%</u>	<u>8%</u>	<u>3%</u>	<u>1%</u>	<u>11%</u>
Bay Shore	( 4)	( 7)	( 1)	( 1)	( 5)
Central Potomac Section	<u>1%</u>	<u>2%</u>	<u>3%</u>	<u>2%</u>	<u>3%</u>
Susquehanna Flats Section	<u>2%</u>	<u>3%</u>	<u>2%</u>	<u>1%</u>	<u>2%</u>
Patuxent River Section	<u>3%</u>	<u>2%</u>	<u>1%</u>	<u>1%</u>	<u>2%</u>
Upper Western Shore Section	<u>1%</u>	<u>2%</u>	<u>2%</u>	<u>+</u>	<u>1%</u>
Lower Potomac Section	<u>0</u>	<u>+</u>	<u>+</u>	<u>1%</u>	<u>1%</u>
Upper Potomac Section	<u>+</u>	<u>+</u>	<u>+</u>	<u>+</u>	<u>2%</u>
Central Western Shore Section	<u>+</u>	<u>+</u>	<u>+</u>	<u>+</u>	<u>+</u>
Lower Western Shore Section	<u>+</u>	<u>+</u>	<u>+</u>	<u>+</u>	<u>+</u>
Total Populations	12,900	51,500	111,700	108,800	32,300

Table 57

FOODS OF 40 BLACK DUCKS FROM BRACKISH ESTUARINE BAYS WITH ADJOINING AGRICULTURAL FIELDS<sup>1</sup>

Leaves, Stems and Rootstalks of Submerged Aquatic Plants	75% (58-88)	Animal Food	45% (29-62)
Claspingleaf Pondweed	50 (33-67)	<i>Macoma balthica</i> (Pelecypoda)	32 (18-50)
Eelgrass	42 (26-59)	<i>Brachidontes recurvus</i> (Pelecypoda)	8 (1-21)
Widgeongrass	28 (14-44)	<i>Gemma gemma</i> (Pelecypoda)	5 (+-17)
Sago Pondweed	2 (+-14)	<i>Volisella demissa</i> (Pelecypoda)	2 (+-14)
Seeds	60 (43-76)	Mytilidae (sp. ?)	2 (+-14)
Widgeongrass	42 (26-59)	<i>Melampus bidentatus</i> (Gastropoda)	2 (+-14)
Claspingleaf Pondweed	28 (14-44)	Undetermined Mollusks	2 (+-14)
Saltgrass	5 (+-17)	Xanthidae	2 (+-14)
Olney Three-square	2 (+-14)	Gammaridae	2 (+-14)
Saltmarsh Bulrush	2 (+-14)	<i>Erichsonella</i> sp. (Isopoda)	2 (+-14)
Hightide-bush	2 (+-14)	<i>Molgula</i> sp. (Tunicata)	2 (+-14)
Undetermined Species	8 (1-21)	Fish	2 (+-14)
Grain	25 (12-42)		
Corn	25 (12-42)		

<sup>1</sup> Chester River, Eastern Bay, and Choptank River Sections. All collected during late fall and winter. Percentage occurrence of foods that made up 5% or more of the volume in individual birds. Figures in parentheses show 95% confidence limits.

Table 58

FOODS OF 8 BLACK DUCKS FROM FRESH ESTUARINE BAY MARSHES IN DORCHESTER COUNTY<sup>1</sup>

Seeds	88% (47-100)	Rootstalks of Emergent Marsh Plants	12% (+-53)
Twigrush	38 (8-76)	Grass (Gramineae)	12 (+-53)
Olney Three-square	25 (3-66)	Animal Food	62 (24-92)
Common Three-square	12 (+-53)	Fish (chiefly, Poeciliidae)	25 (3-66)
Bulrush	12 (+-53)	<i>Mulinia lateralis</i> (Pelecypoda)	12 (+-53)
Rice Cutgrass	12 (+-53)	Mytilidae	12 (+-53)
Widgeongrass	12 (+-53)	Decapoda	12 (+-53)
Smartweed	12 (+-53)	Chironomidae larvae	12 (+-53)
Leaves, Stems and Rootstalks of Submerged Aquatic Plants	38 (8-76)	Belostomatidae	12 (+-53)
Widgeongrass	12 (+-53)		
Claspingleaf Pondweed	12 (+-53)		
Pondweed	12 (+-53)		

<sup>1</sup> Collected during fall, winter and early spring. Percentage occurrence of foods that made up 5% or more of the volume in individual birds. Figures in parentheses show 95% confidence limits.

Table 59

FOODS OF 106 BLACK DUCKS FROM BRACKISH ESTUARINE BAY MARSHES IN DORCHESTER COUNTY<sup>1</sup>

	Sept. 5 Birds	Oct. 13 Birds	Nov. 42 Birds	Dec.-Jan. 29 Birds	March 10 Birds	June 7 Birds
<b>Seeds</b>	<u>60%</u> (14-95)	<u>85%</u> (54-99)	<u>79%</u> (63-90)	<u>86%</u> (68-97)	<u>30%</u> ( 6-66)	<u>57%</u> (18-91)
Olney Three-square	20 ( +-72)	46 (19-75)	43 (27-60)	52 (32-71)		14 ( +-58)
Widgeongrass		23 ( 5-54)	24 (12-40)	27 (12-48)	10 ( +-45)	14 ( +-58)
Saltmarsh Bulrush		23 ( 5-54)	7 ( 1-20)	10 ( 2-28)	10 ( +-45)	29 ( 3-71)
Hightide-bush	20 ( +-72)	54 (25-81)				
Twigrush		15 ( 1-46)	21 (10-37)	10 ( 2-28)		
Dotted Smartweed			7 ( 1-20)	17 ( 5-36)		14 ( +-58)
Saltgrass			10 ( 2-23)	7 ( +-23)	10 ( +-45)	
Saltmarsh Cordgrass			12 ( 3-26)	7 ( +-23)		
Big Cordgrass		8 ( +-37)		3 ( +-18)		
Dodder		8 ( +-37)				
Atriplex		8 ( +-37)				
Sea-lavender		8 ( +-37)				
Groundselbush		8 ( +-37)				
Blue-curls		8 ( +-37)				
Softstem Bulrush				7 ( +-23)		
Walter Millet				3 ( +-18)		
Sago Pondweed				3 ( +-18)		
Waxmyrtle				3 ( +-18)		
Buttonbush			2 ( +-13)			
Blackgum			2 ( +-13)			
Blackberry			2 ( +-13)			
Possum-haw			2 ( +-13)			
<b>Grain</b>		<u>8%</u> ( +-37)	<u>14%</u> ( 5-29)			
Corn		8 ( +-37)	14 ( 5-29)			
Wheat			2 ( +-13)			
<b>Leaves, Stems and Root-stalks of Submerged Aquatic Plants</b>	<u>60%</u> (14-95)	<u>8%</u> ( +-37)	<u>43%</u> (27-60)	<u>38%</u> (20-58)		<u>14%</u> ( +-58)
Widgeongrass	60 (14-95)	8 ( +-37)	33 (19-50)	27 (12-48)		14 ( +-58)
Enteromorpha			2 ( +-13)	7 ( +-23)		

Table 59 (continued)

	Sept. 5 Birds	Oct. 13 Birds	Nov. 42 Birds	Dec.-Jan. 29 Birds	March 10 Birds	June 7 Birds
<b>Leaves, Stems and Root-stalks of Submerged Aquatic Plants (con't)</b>						
Muskgrass			5 ( +-17)			
Sea-lettuce			2 ( +-13)			
Pondweed			2 ( +-13)	3 ( +-18)		
Undetermined Species			2 ( +-13)			
<b>Leaves, Stems and Root-stalks of Emergent Marsh Plants</b>						
		<u>8</u> ( +-37)	<u>2</u> ( +-13)			<u>43</u> ( 9-82)
Saltgrass			2 ( +-13)			43 ( 9-82)
Saltmarsh Cordgrass		8 ( +-37)				14 ( +-58)
<b>Animal Food</b>	<u>100%</u> (47-100)	<u>38%</u> (13-69)	<u>29%</u> (15-45)	<u>55%</u> (35-74)	<u>100%</u> (69-100)	<u>86%</u> (42-100)
<u>Melampus bidentatus</u> (Gastropoda)	100 (47-100)	31 ( 9-62)	10 ( 2-23)	7 ( +-23)	100 (69-100)	
Culicidae larvae						71 (29-97)
Coleoptera		8 ( +-37)		7 ( +-23)	10 ( +-45)	29 ( 3-71)
Fish (chiefly Poeciliidae)			12 ( 3-26)	24 (10-44)	10 ( +-45)	
Amphipoda			2 ( +-13)	7 ( +-23)	10 ( +-45)	14 ( +-58)
<u>Littoridinops</u> sp. (Gastropoda)			5 ( +-17)	10 ( 2-28)		14 ( +-58)
<u>Volisella demissa</u> (Pelecypoda)			5 ( +-17)	3 ( +-18)	10 ( +-45)	
Decapoda			2 ( +-13)	14 ( 3-32)		
Libelluloidea nymphs			5 ( +-17)	10 ( 2-28)		
<u>Gryllotalpa</u> sp. (Orthoptera)		15 ( 1-46)				
<u>Chiridotea coeca</u> (Isopoda)				3 ( +-18)	10 ( +-45)	
Fish eggs					10 ( +-45)	
Belostomatidae			2 ( +-13)	7 ( +-23)		
<u>Nereis</u> sp. (Annelida)				3 ( +-18)		
<u>Bittium varium</u> (Gastropoda)			2 ( +-13)			
<u>Littorina irrorata</u> (Gastropoda)			2 ( +-13)			
Formicidae			2 ( +-13)			

<sup>1</sup> Percentage occurrence of foods that made up 5% or more of the volume in individual birds. Figures in parentheses show 95% confidence limits.



Table 60

FOODS OF 13 BLACK DUCKS FROM SALT ESTUARINE BAY MARSHES OF LOWER EASTERN SHORE SECTION<sup>1</sup>

Animal Food	77% (35-93)	Seeds	38% (13-69)
Fish (chiefly Poeciliidae)	54 (25-81)	Widgeongrass	31 (9-62)
<u>Melampus bidentatus</u> (Gastropoda)	15 (1-46)	Saltgrass	8 (+-37)
<u>Bittium varium</u> (Gastropoda)	15 (1-46)	Saltmarsh Bulrush	8 (+-37)
Amphipoda	15 (1-46)	Hightide-bush	8 (+-37)
Decapoda	8 (+-37)	Needlerush	8 (+-37)
Libelluloidea nymphs	8 (+-37)	Twigrush	8 (+-37)
Heteroptera nymphs	8 (+-37)	Leaves, Stems and Rootstalks of Submerged Aquatic Plants	23 (5-54)
Corixidae	8 (+-37)	Widgeongrass	23 (5-54)
Coleoptera	8 (+-37)		
Grain	15 (1-46)		
Corn	15 (1-46)		

<sup>1</sup> Collected during fall and winter. Percentage occurrence of foods that made up 5% or more of the volume in individual birds. Figures in parentheses show 95% confidence limits.

Table 61

FOODS OF 6 BLACK DUCKS FROM COASTAL SALT MARSHES<sup>1</sup>

Animal Food	100% (54-100)	Seeds (con't)	
<u>Melampus bidentatus</u> (Gastropoda)	67 (22-96)	Twigrush	17% (+-65)
<u>Volselfa demissa</u> (Pelecypoda)	33 (4-78)	Saltgrass	17 (+-65)
Fish	17 (+-65)	Bayberry	17 (+-65)
Amphipoda	17 (+-65)	Leaves, Stems and Rootstalks of Submerged Aquatic Plants	17 (+-65)
Coleoptera	17 (+-65)	Sea-lettuce	17 (+-65)
Seeds	33 (4-78)		
Widgeongrass	33 (4-78)		
Saltmarsh Cordgrass	17 (+-65)		

<sup>1</sup> Collected during late fall, winter and early spring. Percentage occurrence of foods that made up 5% or more of the volume in individual birds. Figures in parentheses show 95% confidence limits.

Table 62

FOODS OF 15 BLACK DUCKS FROM ESTUARINE RIVER MARSHES OF PATUXENT, NANTICOKE, AND ELK RIVERS<sup>1</sup>

Seeds	<u>93%</u> (68-100)	Seeds (con't)	
Dotted Smartweed	60 (32 -84)	Blackberry	7 ( +-32)
Halberdleaf Tearthumb	27 ( 7 -56)	Smartweed	7 ( +-32)
Pickernelweed	20 ( 4 -49)	Bulrush	7 ( +-32)
Arrowleaf Tearthumb	13 ( 1 -41)	Leaves, Stems and Rootstalks of Submerged Aquatic Plants	<u>7%</u> ( +-32)
Wildrice	13 ( 1 -41)	Coontail	7 ( +-32)
Common Burreed	13 ( 1 -41)	Common Waterweed	7 ( +-32)
Giant Burreed	13 ( 1 -41)	Leaves of Emergent Marsh Plants	<u>7</u> ( +-32)
Arrow-arum	13 ( 1 -41)	Grass	7 ( +-32)
Common Three-square	7 ( + -32)	Animal Food	<u>20</u> ( 4-49)
Olney Three-square	7 ( + -32)	Libelluloidea nymphs	7 ( +-32)
Buttonbush	7 ( + -32)	Gammaridae	7 ( +-32)
Rosemallow	7 ( + -32)	Rissoidae	7 ( +-32)
Winterberry	7 ( +-32)	Gastropoda (sp.?)	7 ( +-32)
Panicum	7 ( + -32)		

<sup>1</sup> Collected during early fall and early spring. Percentage occurrence of foods that made up 5% or more of the volume in individual birds. Figures in parentheses show 95% confidence limits.

Table 63

FOODS OF 17 BLACK DUCKS FROM PATUXENT RIVER BOTTOMLANDS<sup>1</sup>

Seeds	65% (38-86)
Hornbeam	41% (18-68)
Poison-ivy	18% ( 3-44)
Blackgum	12% ( 1-37)
Grape	12% ( 1-37)
Dotted Smartweed	12% ( 1-37)
Common Burrreed	6% ( +-29)
Waterpepper	6% ( +-29)
Rice Cutgrass	6% ( +-29)
Sweetgum	6% ( +-29)
Black Cherry	6% ( +-29)
Mast	53% (27-78)
Beech	35% (14-62)
Oak	24% ( 6-50)
Roptstalks of Common Burrreed	6% ( +-29)
Undetermined Herbaceous Leaf Fragments	6% ( +-29)
Animal Food	53% (27-78)
<u>Ambloxis decisum</u> (Gastropoda)	41% (18-68)
<u>Sphaerium</u> sp. (Pelecypoda)	12% ( 1-37)
<u>Physa</u> sp. (Gastropoda)	6% ( +-29)
<u>Gyraulus</u> sp. (Gastropoda)	6% ( +-29)

<sup>1</sup> Collected during fall winter and early spring. Percentage occurrence of foods that made up 5% or more of the volume in individual birds. Figures in parentheses show 95% confidence limits.

Table 64

BIOGEOGRAPHICAL DISTRIBUTION OF HUNTING KILL OF BLACK DUCKS DURING  
THE WINTERS OF 1955-58<sup>1</sup>

Eastern Bay Section	19%	Upper Potomac Section	3%
Choptank River Section	17	Central Potomac Section	2
Chester River Section	14	Patuxent River Section	2
Lower Eastern Shore Section	12	Lower Potomac Section	2
Blackwater-Nanticoke Section	10	Central Western Shore Section	1
Upper Eastern Shore Section	6	Coastal Plain Interior	1
Upper Western Shore Section	5	Lower Western Shore Section	+
Susquehanna Flats Section	4	Total	100%

<sup>1</sup> Based on 741 weighted band recoveries.

Table 65

HARVEST AREAS OF BLACK DUCKS Banded IN CHESTER RIVER-EASTERN BAY AREA  
AND IN DORCHESTER COUNTY MARSHES

Area of Recovery	Distribution of Indirect Recoveries				
	47 Recoveries, Fall-banded (Sept. 21-Oct. 23, 1950-57)	101 Recoveries, Winter-banded (Dec. 22-Feb. 20, 1950-58)	199 Recoveries, Spring-banded (Feb. 21-Apr. 13, 1954-58)	74 Recoveries, Summer-banded (May 22-Aug. 20, 1951-57)	Total 421 Recoveries, Banded 1950-58
Mid-Atlantic States	<u>83%</u>	<u>80%</u>	<u>74%</u>	<u>92%</u>	<u>80%</u>
New Jersey	6	8	9	5	8
Pennsylvania		2			+
Delaware	2	7	5	8	6
Maryland	72	60	60	78	65
Virginia		2	1		1
North Carolina	2		1		+
North-Atlantic States		<u>8%</u>	<u>8%</u>	<u>1%</u>	<u>6%</u>
New York		4	5		3
Rhode Island		1			+
Massachusetts			1		+
Vermont		1	1		+
Maine		2	2	1	1
East-Central Canada	<u>15%</u>	<u>11%</u>	<u>17%</u>	<u>4%</u>	<u>13%</u>
Quebec	9	7	9	3	7
Ontario	6	4	8	1	6
Eastern Canada (N.B. & N.S.)	<u>2%</u>		<u>1%</u>		<u>+</u>
Mid-western States (Ill., Mich., Ohio)		<u>1%</u>	<u>1%</u>	<u>1%</u>	<u>1%</u>
Southern States (Ala., Tenn.)		<u>1%</u>		<u>1%</u>	<u>+</u>
TOTAL	100%	100%	100%	100%	100%

Table 66

## BIOGEOGRAPHICAL DISTRIBUTION OF GADWALLS DURING THE 1958-59 SEASON

	Oct.2-10, 1958	Nov.3-12, 1958	Dec.1-12, 1958	Jan.7-13, 1959	Mar.3-16, 1959
Central Potomac Section	0	97%	50%	76%	96%
Coastal Section	0	+	37	8	0
Lower Eastern Shore Section	0	2	11	6	2
Lower Potomac Section	0	0	1	11	1
Blackwater-Nanticoke Section	0	0	1	0	1
Upper Potomac Section	0	0	0	0	1
Eastern Bay Section	0	+	0	0	0
Choptank River Section	0	0	+	0	0
Other Sections	0	0	0	0	0
Total Populations	0	2,100	3,100	900	1,600

Table 67

FOODS OF 24 GADWALLS FROM BRACKISH ESTUARINE BAY MARSHES OF DORCHESTER COUNTY<sup>1</sup>

Leaves, Stems and Rootstalks of Submerged Aquatic Plants	<u>88%</u> (67-98)	Rootstalks of Emergent Marsh Plants	<u>8%</u> (1-28)
Widgeongrass	67 (44-85)	Saltgrass	8 (1-28)
Eelgrass	17 (4-38)	Seeds	<u>25</u> (9-47)
Muskgrass	12 (2-33)	Olney Three-square	8 (1-28)
Claspingleaf Pondweed	8 (1-28)	Widgeongrass	8 (1-28)
Common Waterweed	4 (+-22)	Saltmarsh Cordgrass	8 (1-28)
Grassleaf Pondweed	4 (+-22)	Claspingleaf Pondweed	4 (+-22)
Pinnate Watermilfoil	4 (+-22)	Animal Food	<u>4</u> (+-22)
Filamentous Green Algae	4 (+-22)	Fish	4 (+-22)

<sup>1</sup> Collected during late fall and winter. Percentage occurrence of foods that made up 5% or more of the volume in individual birds. Figures in parentheses show 95% confidence limits.

Table 68

BIOGEOGRAPHICAL DISTRIBUTION OF PINTAILS DURING  
THE WINTERS OF 1955-58

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Chester River Section	29%	Central Potomac Section	1%
Blackwater-Nanticoke Section	24	Patuxent River Section	1
Lower Eastern Shore Section	23	Susquehanna Flats Section	+
Eastern Bay Section	13	Lower Potomac Section	+
Choptank River Section	5	Upper Potomac Section	+
Upper Eastern Shore Section	3	Other Sections	0
Coastal Section	1	Total	100%

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Table 69

## BIOGEOGRAPHICAL DISTRIBUTION OF PINTAILS DURING THE 1958-59 SEASON

	Oct.2-10, 1958	Nov.3-10, 1958	Dec.1-12, 1958	Jan.7-13, 1959	Mar.3-16, 1959
Chester River Section	<u>64%</u>	<u>41%</u>	<u>61%</u>	<u>40%</u>	<u>67%</u>
Central Chester River	(60)	(20)	(14)	(40)	(+)
Lower Chester River	(4)	(22)	(47)	(0)	(+)
Upper Chester River	(0)	(0)	(0)	(0)	(67)
Lower Eastern Shore Section	<u>3%</u>	<u>16%</u>	<u>12%</u>	<u>24%</u>	<u>1%</u>
Smith Island Area	(2)	(4)	(8)	(23)	(0)
Tar Bay Area	(1)	(11)	(2)	(+)	(+)
Coastal Section	<u>9%</u>	<u>23%</u>	<u>12%</u>	<u>2%</u>	<u>2%</u>
Lower Assateague Area	(9)	(22)	(12)	(1)	(1)
Choptank River Section	<u>4%</u>	<u>2%</u>	<u>4%</u>	<u>24%</u>	<u>9%</u>
Central Choptank	(0)	(2)	(0)	(22)	(1)
Lower Choptank	(3)	(+)	(0)	(2)	(8)
Blackwater-Nanticoke Section	<u>11%</u>	<u>11%</u>	<u>4%</u>	<u>0</u>	<u>4%</u>
Upper Blackwater Area	(11)	(11)	(0)	(0)	(0)
Eastern Bay Section	<u>2%</u>	<u>1%</u>	<u>3%</u>	<u>10%</u>	<u>5%</u>
Upper Eastern Bay	(2)	(1)	(3)	(10)	(4)
Upper Eastern Shore Section	<u>6%</u>	<u>0</u>	<u>5%</u>	<u>0</u>	<u>9%</u>
Bay Shore	(5)	(0)	(5)	(0)	(1)
Sassafras River	(1)	(0)	(0)	(0)	(6)
Central Potomac Section	<u>4%</u>	<u>2%</u>	<u>8%</u>	<u>0</u>	<u>0</u>
Port Tobacco Area	(0)	(0)	(6)	(0)	(0)
Patuxent River Section	<u>0</u>	<u>3%</u>	<u>4%</u>	<u>0</u>	<u>5%</u>
Patuxent Marsh	(0)	(3)	(+)	(0)	(5)
Susquehanna Flats Section	<u>4%</u>	<u>1%</u>	<u>0</u>	<u>0</u>	<u>2%</u>
Other Sections	<u>0</u>	<u>+</u>	<u>0</u>	<u>0</u>	<u>+</u>
Total Populations	3,700	18,700	32,600	13,600	11,500



Table 70

FOODS OF 8 PINTAILS FROM INTERIOR IMPOUNDMENTS ADJOINING AGRICULTURAL FIELDS<sup>1</sup>

Grain	<u>62%</u> ( 24-91)	Seeds (con't)	
Corn	62 ( 24-91)	Little Partridge-pea	12% (+-53)
Seeds	<u>88</u> ( 47-100)	Marsh Smartweed	12 (+-53)
Largeseed Smartweed	50 ( 15-85)	Nodding Smartweed	12 (+-53)
Crabgrass	38 ( 8-76)	Claspingleaf Pondweed	12 (+-53)
Fall Panicum	25 ( 3-66)	Leaves of Herbaceous Plants	<u>12</u> (+-53)
Panicum	25 ( 3-66)	Grass (Gramineae)	12 (+-53)
Foxtail-grass	25 ( 3-66)	Animal Food	<u>12</u> (+-53)
Ladysthumb	25 ( 3-66)	Libelluloidea nymphs	12 (+-53)
Paspalum ( <u>Paspalum laeve</u> )	12 ( +-53)		

<sup>1</sup> 7 from Chester River Section during late fall and winter; 1 from Patuxent Wildlife Research Center in early spring. Percentage occurrence of foods that made up 5% or more of the volume in individual birds. Figures in parentheses show 95% confidence limits.

Table 71

FOODS OF 5 PINTAILS FROM MARGINS OF BRACKISH ESTUARINE BAYS IN  
THE CHESTER RIVER--EASTERN BAY AREA<sup>1</sup>

Seeds	<u>80%</u> (28-100)	Leaves, Stems and Rootstalks of Submerged Aquatic Plants	<u>60%</u> (14-95)
German Millet	40 ( 5-86)	Widgeongrass	20 ( +-72)
Nodding Smartweed	20 ( +-72)	Claspingleaf Pondweed	20 ( +-72)
Largeseed Smartweed	20 ( +-72)	Common Waterweed	20 ( +-72)
Olney Three-square	20 ( +-72)	Animal Food	<u>40</u> ( 5-86)
Widgeongrass	20 ( +-72)	<u>Bittium varium</u> (Gastropoda)	20 ( +-72)
Claspingleaf Pondweed	20 ( +-72)	<u>Cyathura</u> sp. (Isopoda)	20 ( +-72)
Grain	<u>20</u> ( +-72)	Amphithoidae	20 ( +-72)
Corn	20 ( +-72)		

<sup>1</sup> Collected during late fall and winter. Percentage occurrence of foods that made up 5% or more of the volume in individual birds. Figures in parentheses show 95% confidence limits.

Table 72

FOODS OF 13 PINTAILS FROM BRACKISH ESTUARINE BAY MARSHES IN DORCHESTER COUNTY<sup>1</sup>

Seeds	<u>85%</u> (54-99)	Grain	<u>15%</u> (1-46)
Widgeongrass	46 (19-75)	Corn	15 (1-46)
Olney Three-square	23 ( 5-54)	Leaves, Stems and Rootstalks of Submerged Aquatic Plants	<u>38</u> (13-69)
Twigrush	23 ( 5-54)	Widgeongrass	31 (9-62)
Cordgrass	23 ( 5-54)	Sago Pondweed	8 (+-37)
Crabgrass	15 ( 1-46)	Animal Food	<u>31</u> (9-62)
Sago Pondweed	8 ( +-37)	<u>Melampus bidentatus</u> (Gastropoda)	8 (+-37)
Common Burreed	8 ( +-37)	<u>VolSELLA demissa</u> (Pelecypoda)	8 (+-37)
Common Three-square	8 ( +-37)	Libelluloidea nymphs	8 (+-37)
Walter Millet	8 ( +-37)	<u>Molgula manhattensis</u> (Tunicata)	8 (+-37)
Saltgrass	8 ( +-37)		
Buttonbush	8 ( +-37)		
Blackgum	8 ( +-37)		
Waxmyrtle	8 ( +-37)		
Fall Panicum	8 ( +-37)		
Foxtail-grass	8 ( +-37)		

<sup>1</sup> Collected during fall and winter. Percentage occurrence of foods that made up 5% or more of the volume in individual birds. Figures in parentheses show 95% confidence limits.

Table 73

FOODS OF 4 PINTAILS FROM ESTUARINE RIVER MARSHES OF THE PATUXENT RIVER<sup>1</sup>

Seeds	<u>100%</u> (39-100)	Seeds (con't)	
Dotted Smartweed	100 (39-100)	Tidemarch Waterhemp	25% (+-81)
Halberdleaf Tearthumb	50 ( 6-94)	Arrow-arum	25 (+-81)
Common Three-square	50 ( 6-94)	Blackgum	25 (+-81)
Wildrice	25 ( +-81)	Animal Food	<u>25</u> (+-81)
Softstem Bulrush	25 ( +-81)	<u>Pisidium atlanticum</u> (Pelecypoda)	25 (+-81)
Walter Millet	25 ( +-81)		

<sup>1</sup> Three collected in October, 1 in March. Percentage occurrence of foods that made up 5% or more of the volume in individual birds. Figures in parentheses show 95% confidence limits.

Table 74

LOCAL DISTRIBUTION OF HUNTING KILL OF PINTAILS<sup>1</sup>

Lower Eastern Shore Section	43%
Chester River Section	17
Coastal Section	12
Upper Eastern Shore Section	10
Upper Western Shore Section	6
Patuxent River Section	4
Susquehanna Flats Section	4
Choptank River Section	2
Eastern Bay Section	2
Blackwater-Nanticoke Section	+
Other Sections	0
Total	100%

<sup>1</sup> Based on 81 weighted band recoveries.

Table 75

HARVEST AREAS (INDIRECT RECOVERIES) OF PINTAILS Banded IN THE KENT ISLAND, BLACKWATER RIVER, AND SMITH ISLAND AREAS<sup>1</sup>

Mid-Atlantic States	<u>75%</u>
New Jersey	20
Pennsylvania	5
Maryland	20
Virginia	10
North Carolina	20
Eastern Great Lakes Area	<u>15%</u>
Ontario	10
Michigan	5
North-Central States	<u>5%</u>
Wisconsin	5
Prairie Provinces	5%
Manitoba	5
Total	100%

<sup>1</sup> 20 banded September 11-March 4, 1950-58.

Table 76

## ECOLOGICAL DISTRIBUTION OF GREEN-WINGED TEAL DURING THE 1958-59 SEASON

	Oct. 2-10, 1958	Nov. 3-12, 1958	Dec. 1-12, 1958	Jan. 7-13, 1959	Mar. 3-16, 1959
Coastal Salt Marshes with Adjoining Impoundments	<u>21%</u>	<u>59%</u>	<u>42%</u>	<u>0</u>	<u>38%</u>
Estuarine Bay Marshes	<u>43%</u>	<u>17%</u>	<u>35%</u>	<u>84%</u>	<u>34%</u>
Fresh	(16)	( 6)	( 1)	( 0)	( 8)
Brackish	(21)	( 5)	(17)	(13)	( 9)
Salt	( 6)	( 6)	(17)	(71)	(17)
Estuarine River Marshes	<u>36%</u>	<u>24%</u>	<u>23%</u>	<u>16%</u>	<u>28%</u>
Total Populations	1,100	4,800	2,000	200	1,600

Table 77

## BIOGEOGRAPHICAL DISTRIBUTION OF GREEN-WINGED TEAL DURING THE 1958-59 SEASON

	Oct.2-10, 1958	Nov.3-12, 1958	Dec.1-12, 1958	Jan.7-13, 1959	Mar.3-16, 1959
Coastal Section	<u>21%</u>	<u>59%</u>	<u>42%</u>	<u>0</u>	<u>38%</u>
Lower Assateague Area	(21)	(55)	(34)	( 0)	(31)
Blackwater-Nanticoke Section	<u>66%</u>	<u>19%</u>	<u>36%</u>	<u>29%</u>	<u>23%</u>
Upper Nanticoke Marsh	(29)	( 8)	(18)	(16)	( 6)
Lower Blackwater-Nanticoke	(21)	( 5)	(17)	(12)	( 9)
Upper Blackwater Area	(16)	( 6)	( 1)	( 0)	( 8)
Lower Eastern Shore Section	<u>6%</u>	<u>6%</u>	<u>17%</u>	<u>71%</u>	<u>17%</u>
Deal Island-Pocomoke Area	( 2)	( 4)	( 3)	(30)	(10)
Smith Island Area	( 0)	( 0)	( 1)	(29)	( +)
Slaughter Creek Marsh	( 0)	( +)	( 9)	( 4)	( 1)
Elliott Marsh	( 2)	( 2)	( 2)	( 0)	( 6)
Choptank River Section	<u>1%</u>	<u>1%</u>	<u>4%</u>	<u>0</u>	<u>19%</u>
Upper Choptank Marsh	( +)	( 1)	( 4)	( 0)	(19)
Patuxent River Section	<u>5%</u>	<u>12%</u>	<u>0</u>	<u>0</u>	<u>2%</u>
Patuxent Marsh Area	(5)	(12)	( 0)	( 0)	( 2)
Central Potomac Section	<u>0</u>	<u>1%</u>	<u>1%</u>	<u>0</u>	<u>0</u>
Eastern Bay Section	<u>+</u>	<u>1%</u>	<u>0</u>	<u>0</u>	<u>+</u>
Other Sections	<u>+</u>	<u>+</u>	<u>0</u>	<u>0</u>	<u>+</u>
Total Populations	1,100	4,800	2,000	200	1,600

Table 78

FOODS OF 34 GREEN-WINGED TEAL FROM ESTUARINE BAY MARSHES OF DORCHESTER COUNTY<sup>1</sup>

	Sept. 21-Nov. 28 15 Birds	Dec. 3-Jan. 10 9 Birds	Mar. 3-Mar. 24 10 Birds
<b>Seeds</b>	<u>100%</u> (78-100)	<u>100%</u> (66-100)	<u>100%</u> (69-100)
Olney Three-square	93 (68-100)	67 (29-93)	90 (55-100)
Widgeongrass	60 (32-84)	33 (7-71)	80 (44-98)
Twigrush	13 (1-41)	22 (2-61)	10 (+-45)
Saltmarsh Bulrush	7 (+-32)	22 (2-61)	10 (+-45)
Saltgrass	13 (1-41)	11 (+-49)	
Dwarf Spikerush	7 (+-32)		20 (2-56)
Common Three-square			20 (2-56)
Saltmarsh Cordgrass	13 (1-41)		
Hightide-bush	7 (+-32)	11 (+-49)	
Needlerush		11 (+-49)	
Mermaidweed	7 (+-32)		
Softstem Bulrush	7 (+-32)		
Dotted Smartweed		11 (+-49)	
Rice Cutgrass		11 (+-49)	
Cyperus ( <i>C. odoratus</i> )	7 (+-32)		
Fimbristylis ( <i>F. castanea</i> )		11 (+-49)	
<b>Grain</b>	<u>13</u> (1-41)		
Corn	13 (1-41)		
<b>Animal Food</b>	<u>67</u> (38-99)	<u>33</u> (7-71)	<u>70</u> (34-94)
Amphipoda (chiefly Gammaridae)	7 (+-32)	11 (+-49)	50 (18-82)
<i>Littoridinops</i> sp. (Gastropoda)	20 (4-49)	11 (+-49)	
<i>Leptochelia savignyi</i> (Isopoda)	13 (1-41)	22 (2-61)	
Ostracoda	7 (+-32)		20 (2-56)
<i>Melampus bidentatus</i> (Gastropoda)			30 (6-66)
Chironomidae larvae	7 (+-32)		20 (2-56)
<i>Chiridotea coeca</i> (Isopoda)	13 (1-41)		
<i>Bittium varium</i> (Gastropoda)	7 (+-32)		
Insect (sp.?)	7 (+-32)		
Diptera larvae	7 (+-32)		

<sup>1</sup> Percentage occurrence of foods that made up 5% or more of the volume in individual birds. Figures in parentheses show 95% confidence limits.

Table 79

FOODS OF 8 GREEN-WINGED TEAL FROM ESTUARINE RIVER MARSHES  
OF THE PATUXENT AND NANTICOKE RIVERS<sup>1</sup>

Seeds	<u>100%</u> (63-100)
Dotted Smartweed	88 (47-100)
Softstem Bulrush	50 (15- 85)
River Bulrush	38 ( 8- 76)
Halberdleaf Tearthumb	38 ( 8- 76)
Arrowleaf Tearthumb	25 ( 3- 66)
Tidemarth Waterhemp	12 ( +- 53)
Rice Cutgrass	12 ( +- 53)
Walter Millet	12 ( +- 53)
Arrowhead	12 ( +- 53)
Ribbonleaf Pondweed	12 ( +- 53)
Animal Food	<u>12</u> ( +- 53)
<u>Corophium</u> sp. (Amphipoda)	12 ( +- 53)

<sup>1</sup> Collected during October, late March, and early April. Percentage occurrence of foods that made up 5% or more of the volume in individual birds. Figures in parentheses show 95% confidence limits.

Table 80

FOODS OF 43 BLUE-WINGED TEAL FROM BRACKISH ESTUARINE BAY MARSHES IN DORCHESTER COUNTY<sup>1</sup>

	Sept. - Oct. 22 Birds	Nov. - Jan. 6 Birds	March 7 Birds	June 8 Birds
<b>Seeds</b>	<u>100%</u> (84-100)	<u>100%</u> (54-100)	<u>86%</u> (42-100)	<u>88%</u> (47-100)
Olney Three-square	86 (65- 98)	67 (22- 96)	71 (29- 97)	62 (24- 92)
Widgeongrass	36 (17- 60)	33 ( 4- 78)	86 (42-100)	75 (34- 97)
Saltmarsh Bulrush	9 ( 1- 30)	33 ( 4- 78)	29 ( 3- 71)	12 ( +- 53)
Twigrush	14 ( 2- 35)	17 ( +- 65)	29 ( 3- 71)	
Saltgrass	5 ( +- 23)	17 ( +-65 )		12 ( +- 53)
Hightide-bush	23 ( 7- 46)			
Cordgrass	9 ( 1- 30)			
Softstem Bulrush	5 ( +- 23)			
Sago Pondweed	5 ( +- 23)			
Claspingleaf Pondweed	5 ( +- 23)			
<b>Grain</b>		<u>17</u> ( +- 65)		
Corn		17 ( +- 65)		
<b>Leaves, Stems and Rootstalks of Submerged Aquatic Plants</b>	<u>18</u> ( 5- 41)			<u>12</u> ( +-53)
Muskgrass	9 ( 1- 30)			
Widgeongrass	5 ( +- 23)			12 ( +-53)
Pondweed	5 ( +- 23)			
<b>Animal Food</b>	<u>23</u> ( 7- 46)	<u>33</u> (4-78)	<u>86</u> (42-100)	<u>75</u> (34-97)
<u>Littoridinops</u> sp. (Gastropoda)	9 ( 1- 30)		71 (29- 97)	38 ( 8-76)
Coleoptera (sp. ?)			14 ( +- 58)	25 ( 3-66)
Ostracoda		17 ( +-65)	29 ( 3- 71)	
<u>Melampus bidentatus</u> (Gastropoda)	5 ( +- 23)			
Fish Eggs				25 ( 3-66)
<u>VolSELLA demissa</u> (Pelecypoda)			14 ( +- 58)	
Gastropoda (sp. ?)		17 ( +-65)		
Libelluloidea larvae-pupae				12 ( +-53)
Curculionidae	9 (1- 30)			
Formicidae	5 ( +- 23)			

<sup>1</sup> Percentage occurrence of foods that made up 5% or more of the volume in individual birds. Figures in parentheses show 95% confidence limits.



Table 81

FOODS OF 10 BLUE-WINGED TEAL FROM ESTUARINE RIVER MARSHES  
OF PATUXENT, NANTICOKE, AND ELK RIVERS<sup>1</sup>

Seeds	<u>100%</u> (69-100)
Dotted Smartweed	80 (44- 98)
Walter millet	60 (26- 88)
Dodder	50 (18- 82)
Softstem Bulrush	40 (12- 74)
Tidemarth Waterhemp	30 ( 6- 66)
Halberdleaf Tearthumb	30 ( 6- 66)
Common Burrreed	30 ( 6- 66)
Giant Burrreed	20 ( 2- 56)
Arrowleaf Tearthumb	20 ( 2- 56)
Common Three-square	20 ( 2- 56)
Pickereelweed	20 ( 2- 56)
Wildrice	10 ( +- 45)
Common Spikerush	10 ( +- 45)
Sedge ( <u>Carex crinita</u> )	10 ( +- 45)
Leaves of Emergent Marsh Plants	<u>10</u> ( +- 45)
Grass (Gramineae)	10 ( +- 45)

<sup>1</sup> Collected during early fall. Percentage occurrence of foods that made up 5% or more of the volume in individual birds. Figures in parentheses show 95% confidence limits.

Table 82

HARVEST AREAS OF BLUE-WINGED TEAL BANDED AT  
BLACKWATER NATIONAL WILDLIFE REFUGE<sup>1</sup>

West Indian-Northeast South American Areas	<u>53%</u>
Bahama Islands	11
Cuba	11
Dominican Republic	5
Puerto Rico	5
Barbadoes	5
Trinidad	5
British Guiana	5
Brazil	5
Eastern Great Lakes--St. Lawrence Area	<u>21%</u>
Quebec	11
Ontario	5
Michigan	5
North-Central States	<u>21%</u>
Minnesota	16
Wisconsin	5
Mid-Atlantic States	<u>5%</u>
Maryland	5
TOTAL	100%

<sup>1</sup> 17 banded September 8 - October 15. 2 banded April 4-10.

Table 83

FOODS OF 12 SHOVELERS FROM BRACKISH ESTUARINE BAY MARSHES  
IN DORCHESTER COUNTY<sup>1</sup>

	Nov. 8-Jan. 10, 9 Birds	Mar. 21-April 19, 3 Birds
<b>Seeds</b>	<u>89%</u> (51-100)	<u>33%</u> (+-91)
Olney Three-square	33 (7-71)	33 (+-91)
Widgeongrass	33 (7-71)	
Saltgrass	22 (2-61)	
Twigrush	11 (+-49)	
Dodder	11 (+-49)	
<b>Leaves, Stems and Rootstalks of Submerged Aquatic Plants</b>	<u>22%</u> (2-61)	<u>0</u>
Muskgrass	22 (2-61)	
Widgeongrass	11 (+-49)	
<b>Rootstalks of Emergent Marsh Plants</b>	<u>11%</u> (+-49)	<u>0</u>
Cordgrass	11 (+-49)	
<b>Animal Food</b>	<u>56%</u> (27-85)	<u>100%</u> (29-100)
<u>Littoridinops</u> sp. (Gastropoda)	33 (7-71)	33 (+- 91)
Copepoda		100 (29-100)
Fish (Chiefly Poeciliidae)	22 (2-61)	
Amphipoda	11 (+-49)	
Cladocera	11 (+-49)	
<u>Bittium varium</u> (Gastropoda)	11 (+-49)	

<sup>1</sup> Percentage occurrence of foods that made up 5% or more of the volume in individual birds. Figures in parentheses show 95% confidence limits.

Table 84

## ECOLOGICAL DISTRIBUTION OF AMERICAN WIDGEONS DURING THE 1958-59 SEASON

	Oct.2-10, 1958	Nov.3-12, 1958	Dec.1-12, 1958	Jan.7-13, 1959	Mar.3-16, 1959
Fresh Estuarine Bays	33%	10%	2%	2%	2%
Slightly Brackish Estuarine Bays	11%	14%	27%	8%	14%
Brackish Estuarine Bays	42%	41%	51%	85%	71%
Fresh and Brackish Estuarine Bay Marshes	4%	15%	+	0	+
Salt Estuarine Bays and Salt Estuarine Bay Marshes	5%	6%	8%	3%	3%
Coastal Embayed Salt Marshes and Adjoining Impoundments	5%	14%	12%	2%	10%
Total Populations	40,200	77,700	36,700	19,500	21,600

Table 85

BIOGEOGRAPHICAL DISTRIBUTION OF AMERICAN WIDGEONS  
DURING THE WINTERS OF 1955-58

Chester River Section	30%	Lower Potomac Section	1%
Eastern Bay Section	24	Patuxent River Section	1
Choptank River Section	12	Lower Western Shore Section	1
Lower Eastern Shore Section	8	Coastal Section	+
Upper Eastern Shore Section	8	Central Western Shore Section	+
Susquehanna Flats Section	7	Upper Western Shore Section	0
Blackwater-Nanticoke Section	6	Upper Potomac Section	0
Central Potomac Section	4	Total	100%

Table 86

## BIOGEOGRAPHICAL DISTRIBUTION OF AMERICAN WIDGEONS DURING THE 1958-59 SEASON

	Oct.2-10, 1958	Nov.3-12, 1958	Dec.1-12, 1958	Jan. 7-13, 1959	Mar.3-16, 1959
Chester River Section	<u>30%</u>	<u>23%</u>	<u>20%</u>	<u>44%</u>	<u>33%</u>
Central Chester River	(17)	(17)	(11)	(44)	( 8)
Lower Chester River	(13)	( 6)	(10)	( +)	( 1)
Upper Chester River	( +)	( +)	( 0)	( +)	(24)
Central Potomac Section	<u>11%</u>	<u>13%</u>	<u>25%</u>	<u>7%</u>	<u>11%</u>
Susquehanna Flats Section	<u>33%</u>	<u>9%</u>	<u>1%</u>	<u>0</u>	<u>+</u>
Choptank River Section	<u>5%</u>	<u>8%</u>	<u>11%</u>	<u>19%</u>	<u>19%</u>
Central Choptank	( 3)	( 7)	( 4)	(10)	( 1)
Lower Choptank	( 2)	( 1)	( 8)	( 7)	(16)
Coastal Section	<u>5%</u>	<u>14%</u>	<u>12%</u>	<u>2%</u>	<u>10%</u>
Southern Assateague	( 5)	(14)	(11)	( 1)	( 7)
Eastern Bay Section	<u>4%</u>	<u>4%</u>	<u>10%</u>	<u>8%</u>	<u>12%</u>
Upper Eastern Bay	( 3)	( 3)	( 9)	( 4)	(10)
Blackwater-Nanticoke Section	<u>4%</u>	<u>15%</u>	<u>+</u>	<u>0</u>	<u>+</u>
Lower Blackwater-Nanticoke	( 3)	(15)	( 0)	( 0)	( +)
Lower Eastern Shore Section	<u>5%</u>	<u>6%</u>	<u>7%</u>	<u>3%</u>	<u>3%</u>
Central Western Shore Section	<u>1%</u>	<u>2%</u>	<u>6%</u>	<u>5%</u>	<u>1%</u>
Lower Potomac Section	<u>1%</u>	<u>1%</u>	<u>3%</u>	<u>9%</u>	<u>6%</u>
Patuxent River Section	<u>1%</u>	<u>3%</u>	<u>2%</u>	<u>+</u>	<u>+</u>
Upper Eastern Shore Section	<u>+</u>	<u>+</u>	<u>0</u>	<u>3%</u>	<u>4%</u>
Upper Western Shore Section	<u>+</u>	<u>2%</u>	<u>2%</u>	<u>0</u>	<u>1%</u>
Lower Western Shore Section	<u>+</u>	<u>0</u>	<u>0</u>	<u>+</u>	<u>+</u>
Upper Potomac Section	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>+</u>
Total Populations	40,200	77,700	36,700	19,500	21,600

Table 87

FOODS OF 57 AMERICAN WIDGEONS FROM BRACKISH ESTUARINE BAYS OF THE  
CHESTER RIVER-EASTERN BAY AREA<sup>1</sup>

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Leaves, Stems and Rootstalks of Submerged Aquatic Plants	<u>98%</u> (91-100)
Claspingleaf Pondweed	70% (56 -82)
Eelgrass	53% (30 -67)
Widgeongrass	47% (33 -70)
Common Waterweed	11% ( 3 -22)
Sea-lettuce	4% ( + -13)
Sago Pondweed	2% ( + - 9)
Southern Naiad	2% ( + - 9)
Enteromorpha	2% ( + - 9)
Filamentous Green Algae	2% ( + - 9)
Leaves of Emergent Marsh Plants	<u>2%</u> ( + - 9)
Saltmarsh Cordgrass	2% ( + - 9)
Seeds	<u>5%</u> ( 1 -15)
Claspingleaf Pondweed	4% ( + -13)
German Millet	2% ( + - 9)
Grain	<u>2%</u> ( + - 9)
Corn	2% ( + - 9)
Animal Food	<u>2%</u> ( + - 9)
<u>Macoma balthica</u> (Pelecypoda)	2% ( + - 9)

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<sup>1</sup> Collected November-January. Percentage occurrence of foods that made up 5% or more of the volume in individual birds. Figures in parentheses show 95% confidence limits.

Table 88

FOODS OF 86 AMERICAN WIDGEONS FROM ESTUARINE BAY MARSHES OF DORCHESTER COUNTY<sup>1</sup>

	Brackish Estuarine Bay			Fresh Estuarine Bay
	Oct.-Nov. 50 Birds	Marsh Dec.-Jan. 30 Birds	March 3 Birds	Marsh November 3 Birds
Leaves, Stems and Rootstalks of Submerged Aquatic Plants	<u>90%</u> (78-97)	<u>97%</u> (73-98)	<u>100%</u> (29-100)	<u>100%</u> (29-100)
Widgeongrass	72 (57-84)	90 (73-98)	67 (9-100)	67 (9-100)
Muskgrass	28 (16-43)	17 (5-35)	100 (29-100)	33 (+- 91)
Claspingleaf Pondweed				100 (29-100)
Sago Pondweed		7 (+-23)		
Eelgrass		3 (+-18)		
Filamentous Green Algae	2 (+-11)			
Leaves and Rootstalks of Emergent Marsh Plants	<u>8%</u> (2-20)	<u>3%</u> (+-18)	<u>0</u>	<u>0</u>
Saltgrass	4 (+-14)	3 (+-18)		
Saltmarsh Cordgrass	4 (+-14)			
Seeds	<u>8%</u> (2-20)	<u>3%</u> (+-18)	<u>33%</u> (+- 91)	<u>0</u>
Saltgrass	6 (1-17)			
Widgeongrass	2 (+-11)	3 (+-18)	33 (+-91)	
Olney Three-square	2 (+-11)	3 (+-18)		
Twigrush	2 (+-11)			
Common Spikerush	2 (+-11)			
Animal Food	<u>0</u>	<u>3%</u> (+-18)	<u>0</u>	<u>33%</u> (+-91)
<u>Bittium varium</u> (Gastropoda)				33 (+-91)
Hydromedusae		3 (+-18)		

<sup>1</sup> Percentage occurrence of foods that made up 5% or more of the volume in individual birds. Figures in parentheses show 95% confidence limits.

Table 89

LOCAL DISTRIBUTION OF HUNTING KILL OF AMERICAN WIDGEONS<sup>1</sup>

Central Potomac Section	16%	Susquehanna Flats Section	4%
Choptank River Section	15	Coastal Section	3
Eastern Bay Section	14	Upper Potomac Section	2
Chester River Section	13	Blackwater-Nanticoke Section	2
Lower Eastern Shore Section	12	Lower Potomac Section	2
Central Western Shore Section	6	Patuxent River Section	1
Upper Western Shore Section	5	Lower Western Shore Section	0
Upper Eastern Shore Section	5	Total	100%

<sup>1</sup> Based on 69 weighted band recoveries.



Table 90

HARVEST AREAS (INDIRECT RECOVERIES) OF AMERICAN WIDGEONS Banded IN  
THE CHESTER RIVER--EASTERN BAY AND GIBSON ISLAND AREAS<sup>1</sup>

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Mid-Atlantic States	<u>80%</u>
New Jersey	3
Delaware	7
Maryland	53
Virginia	10
North Carolina	7
Eastern Great Lakes Area	<u>10%</u>
New York	3
Ontario	3
Michigan	3
Prairie Provinces	<u>3%</u>
Manitoba	3
Southeastern States	<u>3%</u>
Florida	3
South-Central States	<u>3%</u>
Texas	3
TOTAL	100%

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<sup>1</sup> 30 banded January 23-March 30, 1953-58.

Table 91

FOODS OF 57 WOOD DUCKS FROM PATUXENT RIVER BOTTOMLANDS<sup>1</sup>

	Sept. - Oct.			Nov. - Dec.	
	1954	1956	1957	1954	Other Years
	17 Birds	4 Birds	7 Birds	21 Birds	(1945-55) 8 Birds
Mast	88% (63-99)	100% (39-100)	14% (+-58)	100% (83-100)	88% (47-100)
Beech	12 (1-37)		14 (+-58)	90 (69-99)	50 (15-85)
White Oak	76 (50-94)			19 (5-42)	
Pin Oak		100 (39-100)			50 (15-85)
Willow Oak					13 (+-53)
Fruits and Seeds	41% (18-68)	0	100% (59-100)	38% (18-62)	50% (15-85)
Halberdleaf Tearthumb			100 (59-100)		13 (+-53)
Hornbeam	12 (1-37)		14 (+-58)	24 (8-48)	
Blackgum	24 (6-50)				
Sweetgum				14 (3-37)	13 (+-53)
Common Burreed	6 (+-29)			14 (3-37)	
Grape	6 (+-29)			5 (+-24)	
Winterberry			14 (+-58)		
Poison-ivy					13 (+-53)
Sedge ( <i>Carex folliculata</i> )					13 (+-53)
Sedge ( <i>Carex intumescens</i> )					13 (+-53)
Leaves of Submerged Aquatic Plants	41% (18-68)	0	57% (18-91)	14% (3-37)	0
Ribbonleaf Pondweed	35 (14-62)			10 (1-31)	
Nuttall Waterweed			57 (18-91)		
Nitella	6 (+-29)			5 (+-24)	
Spirogyra	6 (+-29)				
Animal Food	0	0	0	0	13% (+-53)
Araneida					13 (+-53)

<sup>1</sup> Within or near the Patuxent Wildlife Research Center. Percentage occurrence of foods that made up 5% or more of the volume in individual birds. Figures in parentheses show 95% confidence limits.

Table 92

FOODS OF 20 WOOD DUCKS FROM ESTUARINE RIVER MARSHES<sup>1</sup>

Seeds	<u>100%</u> (83-100)
Arrow-arum	60 ( 36-81)
Giant Burreed	30 ( 12-54)
Halberdleaf Tearthumb	15 ( 3-38)
Swamp Rose	10 ( 1-31)
Silky Dogwood	10 ( 1-31)
Common Burreed	10 ( 1-31)
Wildrice	10 ( 1-31)
Winterberry	5 ( +-25)
Rosemallow	5 ( +-25)
Southern Smartweed	5 ( +-25)
Smartweed	5 ( +-25)
Pondweed	5 ( +-25)
Sedge ( <u>Carex lurida</u> )	5 ( +-25)
Sedge ( <u>Carex lupulina</u> )	5 ( +-25)
Rootstalks	<u>5</u> ( +-25)
Undetermined species	5 ( +-25)
Corn	<u>5</u> ( +-25)

<sup>1</sup> Collected August 27-October 3 and March 7-April 5, 14 from Patuxent River Marsh, 3 from Elk River Marsh, 3 from Upper Potomac section. Percentage occurrence of foods that made up 5% or more of the volume in individual birds. Figures in parentheses show 95% confidence limits.

Table 93

LOCAL DISTRIBUTION OF HUNTING KILL OF WOOD DUCKS<sup>1</sup>

Choptank River Section	25%
Blackwater-Nanticoke Section	22
Upper Western Shore, Susquehanna Flats and Upper Eastern Shore Sections	11
Coastal Plain Interior (chiefly, east of Chesapeake Bay)	10
Potomac and Patuxent River Sections	10
Lower Eastern Shore Section	9
Coastal Section	8
Chester River and Eastern Bay Sections	5
Central and Lower Western Shore Sections	0
Total	100%

<sup>1</sup> Based on 29 weighted band recoveries.

Table 94

## ECOLOGICAL DISTRIBUTION OF REDHEADS DURING THE 1958-59 SEASON

	Nov.3-12, 1958	Dec.1-12, 1958	Jan.7-13, 1959	Mar.3-16, 1959
Fresh Estuarine Bays	99%	73%	0	78%
Slightly Brackish Estuarine Bays	0	2%	0	2%
Brackish Estuarine Bays	1%	24%	81%	17%
Salt Estuarine Bays	0	1%	19%	3%
Total Populations	3,500	22,000	49,400	59,400

Table 95

## BIOGEOGRAPHICAL DISTRIBUTION OF REDHEADS DURING THE WINTERS OF 1955-58

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Choptank River Section	25%
Eastern Bay Section	14
Susquehanna Flats Section	13
Blackwater-Nanticoke Section	11
Lower Eastern Shore Section	10
Chester River Section	7
Central Potomac Section	7
Lower Potomac Section	6
Coastal Section	2
Patuxent River Section	2
Upper Eastern Shore Section	1
Central Western Shore Section	1
Upper Western Shore Section	1
Upper Potomac Section	0
Lower Western Shore Section	0
Total	100%

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Table 96

## BIOGEOGRAPHICAL DISTRIBUTION OF REDHEADS DURING THE 1958-59 SEASON

	Nov.3-12, 1958	Dec.1-12, 1958	Jan.7-13, 1959	Mar.3-16, 1959
Susquehanna Flats Section	<u>99%</u>	<u>17%</u>	<u>0</u>	<u>75%</u>
Eastern Bay Section	<u>0</u>	<u>0</u>	<u>48%</u>	<u>1%</u>
Upper Eastern Bay	(0)	(0)	(47)	(+)
Choptank River Section	<u>0</u>	<u>9%</u>	<u>31%</u>	<u>1%</u>
Central Choptank Area	(0)	(9)	(9)	(+)
North Shore-Lower Choptank	(0)	(0)	(18)	(1)
Upper Western Shore Section	<u>(0)</u>	<u>57%</u>	<u>0</u>	<u>+%</u>
Spesutie-Pooles Island Area	(0)	(56)	(0)	(+)
Lower Eastern Shore Section	<u>0</u>	<u>1%</u>	<u>18%</u>	<u>3%</u>
Honga River Area	(0)	(0)	(18)	(0)
Blackwater-Nanticoke Section	<u>0</u>	<u>+%</u>	<u>0</u>	<u>13%</u>
Lower Nanticoke Area	(0)	(+)	(0)	(13)
Chester River Section	<u>1%</u>	<u>6%</u>	<u>2%</u>	<u>+%</u>
Patuxent River Section	<u>0</u>	<u>6%</u>	<u>+%</u>	<u>0</u>
Upper Potomac Section	<u>0</u>	<u>0</u>	<u>0</u>	<u>3%</u>
Central Potomac Section	<u>0</u>	<u>1%</u>	<u>0</u>	<u>1%</u>
Lower Potomac Section	<u>0</u>	<u>1%</u>	<u>+%</u>	<u>1%</u>
Central Western Shore Section	<u>0</u>	<u>2%</u>	<u>0</u>	<u>+%</u>
Lower Western Shore Section	<u>0</u>	<u>0</u>	<u>+%</u>	<u>0</u>
Other Sections	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
Total Population	3,500	22,000	49,400	59,400

Table 97

FOODS OF 11 REDHEADS FROM FRESH ESTUARINE BAYS OF  
THE POTOMAC, GUNPOWDER, AND BUSH RIVERS<sup>1</sup>

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Leaves, Stems and Rootstalks of Submerged Aquatic Plants	64% (30-90)
Pondweed	45 (16-77)
Sago Pondweed	18 ( 2-52)
Naiad	9 ( +-42)
Grassleaf Pondweed	9 ( +-42)
Seeds	55% (23-84)
Naiad	18 ( 2-52)
Sago Pondweed	9 ( +-42)
Widgeongrass	9 ( +-42)
Common Waterweed	9 ( +-42)
Bulrush	9 ( +-42)
Wildrice	9 ( +-42)
Animal Food	18% ( 2-52)
<u>Planorbis parvus</u> (Gastropoda)	18 ( 2-52)

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<sup>1</sup> Collected during late fall, winter, and early spring. Percentage occurrence of foods that made up 5% or more of the volume in individual birds. Figures in parentheses show 95% confidence limits.

Table 98

FOODS OF 81 REDHEADS FROM BRACKISH ESTUARINE BAYS OF THE CHESTER RIVER,  
EASTERN BAY, AND CHOPTANK RIVER<sup>1</sup>


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Leaves, Stems and Rootstalks of	
Submerged Aquatic Plants	<u>90%</u> (81-96)
Claspingleaf Pondweed	53 (41-65)
Eelgrass	30 (20-42)
Widgeongrass	14 ( 7-24)
Common Waterweed	14 ( 7-24)
Sea-lettuce	5 ( 1-13)
Enteromorpha	1 ( +-7)
Pondweed	1 ( +-7)
Grain	<u>23%</u> (14-34)
Corn (bait)	23 (14-34)
Seeds	<u>28%</u> (18-40)
Claspingleaf Pondweed	25 (15-36)
Widgeongrass	6 ( 2-14)
Olney Three-square	1 ( + -7)
Animal Food	<u>10%</u> ( 4-19)
Xanthidae	5 ( 1-13)
<u>Macoma balthica</u> (Pelecypoda)	2 ( +- 9)
<u>Mya arenaria</u> (Pelecypoda)	1 ( +- 7)
Amphipoda	1 ( +- 7)

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<sup>1</sup> Collected during late fall and winter. Percentage occurrence of foods that made up 5% or more of the volume in individual birds. Figures in parentheses show 95% confidence limits.



Table 99

FOODS OF 6 REDHEADS FROM SALT ESTUARINE BAYS IN  
THE HOLLAND ISLAND AND SAXIS ISLAND AREAS<sup>1</sup>

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Leaves, Stems and Rootstalks of Submerged Aquatic Plants	<u>50%</u> (11-89)
Eelgrass	33 ( 4-78)
Widgeongrass	17 ( +-65)
Claspingleaf Pondweed	17 ( +-65)
Grain (bait)	<u>83%</u> (35-100)
Corn	83 (35-100)
Sorghum	33 ( 4-78)
Animal Food	<u>33%</u> ( 4-78)
<u>Erichsonella filiformis</u> (Isopoda)	17 ( +-65)
<u>Gemma gemma</u> (Pelecypoda)	17 ( +-65)

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<sup>1</sup> Collected during late fall and winter. Percentage occurrence of foods that made up 5% or more of the volume in individual birds. Figures in parentheses show 95% confidence limits.

Table 100

LOCAL DISTRIBUTION OF HUNTING KILL OF REDHEADS<sup>1</sup>

Chester River Section	23%
Lower Eastern Shore Section	18
Eastern Bay Section	18
Choptank River Section	13
Upper Eastern Shore Section	6
Upper Western Shore Section	6
Susquehanna Flats Section	5
Lower Potomac Section	3
Central Potomac Section	2
Central Western Shore Section	2
Patuxent River Section	2
Blackwater-Nanticoke Section	1
Coastal Section	1
Lower Western Shore Section	+
Upper Potomac Section	+
Total	100%

<sup>1</sup> Based on 482 weighted band recoveries.

Table 101

HARVEST AREAS OF REDHEADS Banded IN THE UPPER CHESAPEAKE REGION<sup>1</sup>

	Distribution of Indirect Recoveries		
	91 Recoveries Winter-Banded Jan.2-Feb.20, 1953-57	481 Recoveries Spring-Banded Feb.21-April 1, 1953-58	Total 572 Recoveries Banded 1953-58
Mid-Atlantic States	<u>53%</u>	<u>45%</u>	<u>47%</u>
Maryland	42	33	35
Virginia	2	4	4
North Carolina	8	7	7
Other (N. J., Penn.)	1	1	1
Eastern Great Lakes - St. Lawrence	<u>23%</u>	<u>17%</u>	<u>18%</u>
New York	7	1	2
Ontario	4	4	4
Michigan	10	10	10
Other (Ohio, Quebec)	2	2	2
North-Central States	<u>18%</u>	<u>22%</u>	<u>21%</u>
Wisconsin	3	5	5
Minnesota	12	14	14
Other (N.D., S.D.)	2	3	3
Prairie Provinces	<u>4%</u>	<u>8%</u>	<u>8%</u>
Manitoba	1	7	6
Other (Alta, Sask.)	3	1	2
Southeastern States (Ala. Fla., Ga., S. C.)	<u>0</u>	<u>2%</u>	<u>2%</u>
South-Central States (Ark., La., Okla., Tex.)	<u>2%</u>	<u>2%</u>	<u>2%</u>

Table 101 (continued)

	<u>Distribution of Indirect Recoveries</u>		
	91 Recoveries Winter-Banded Jan.2-Feb.20, 1953-57	481 Recoveries Spring-Banded Feb.21-April 1, 1953-58	Total 572 Recoveries Banded 1953-58
Mid-Western States (Ia., Ill., Kan., Mo., Neb.)	<u>0</u>	<u>2%</u>	<u>2%</u>
Western States (Ariz., Calif., Nev., Utah)	<u>0</u>	<u>1%</u>	<u>1%</u>
TOTAL	100%	100%	100%

<sup>1</sup> Banded in Chester River, Eastern Bay, Hooper Island, Solomons and Gibson Island Areas.

Table 102

BIOGEOGRAPHICAL DISTRIBUTION OF RING-NECKED DUCKS  
DURING THE WINTERS OF 1955-58

Blackwater-Nanticoke Section	67%
Eastern Bay Section	24%
Chester River Section	4%
Coastal Section	4%
Central Potomac Section	1%
Other Sections	0
Total	100%

Table 103

## BIOGEOGRAPHICAL DISTRIBUTION OF RING-NECKED DUCKS DURING THE 1958-59 SEASON

	Nov.3-12, 1958	Dec.1-12, 1958	Jan.7-13, 1959	Mar.3-16, 1959
Choptank River Section	<u>0</u>	<u>0</u>	<u>72%</u>	<u>20%</u>
Central Choptank	(0)	(0)	(72)	(1)
Lower Choptank	(0)	(0)	( 0)	(19)
Susquehanna Flats Section	<u>76%</u>	<u>0</u>	<u>0</u>	<u>0</u>
Chester River Section	<u>10%</u>	<u>40%</u>	<u>+</u>	<u>4%</u>
Central Chester River	(10)	(37)	(+)	(4)
Upper Eastern Shore Section	<u>+</u>	<u>0</u>	<u>0</u>	<u>31%</u>
Bay Shore Area	(0)	(0)	(0)	(31)
Central Western Shore Section	<u>0</u>	<u>24%</u>	<u>+</u>	<u>5%</u>
Central Potomac Section	<u>+</u>	<u>18%</u>	<u>3%</u>	<u>3%</u>
Lower Eastern Shore Section	<u>0</u>	<u>0</u>	<u>1%</u>	<u>20%</u>
Lower Potomac Section	<u>0</u>	<u>4%</u>	<u>2%</u>	<u>10%</u>
Upper Western Shore Section	<u>11%</u>	<u>+</u>	<u>0</u>	<u>3%</u>
Blackwater-Nanticoke Section	<u>+</u>	<u>11%</u>	<u>+</u>	<u>0</u>
Coastal Section	<u>0</u>	<u>+</u>	<u>10%</u>	<u>1%</u>
Lower Western Shore Section	<u>0</u>	<u>0</u>	<u>10%</u>	<u>0</u>
Eastern Bay Section	<u>3%</u>	<u>1%</u>	<u>0</u>	<u>1%</u>
Upper Potomac Section	<u>0</u>	<u>2%</u>	<u>0</u>	<u>+</u>
Patuxent River Section	<u>0</u>	<u>0</u>	<u>0</u>	<u>+</u>
Total Populations	2,000	2,800	1,000	5,000

Table 104

FOODS OF 17 RING-NECKED DUCKS FROM FRESH ESTUARINE BAYS  
OF THE POTOMAC RIVER<sup>1</sup>

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Leaves, Stems and Rootstalks of Submerged Aquatic Plants	<u>82%</u> (56-97)
Pondweed	53 (27-78)
Naiad	24 ( 6-50)
Wildcelery	6 ( +-29)
Sago Pondweed	6 ( +-29)
Grassleaf Pondweed	6 ( +-29)
Animal Food	<u>47%</u> (22-73)
<u>Oxytrema virginica</u> (Gastropoda)	35 (14-62)
Trichoptera larvae	6 ( +-29)

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<sup>1</sup> Collected November 10-March 23. Percentage occurrence of foods that made up 5% or more of the volume in individual birds. Figures in parentheses show 95% confidence limits.

Table 105

FOODS OF 10 RING-NECKED DUCKS FROM INTERIOR IMPOUNDMENTS  
IN PRINCE GEORGES COUNTY<sup>1</sup>

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Mast	<u>10%</u> (+-45)
Pin Oak	10 (+-45)
Seeds	<u>30%</u> (6-66)
Dotted Smartweed	10 (+-45)
Rice Cutgrass	10 (+-45)
Common Burreed	10 (+-45)
Squarestem Spikerush	10 (+-45)
Grain	<u>10%</u> (+-45)
Corn (bait)	10 (+-45)
Animal Food	<u>80%</u> (44-98)
Chironomidae larvae	60 (26-88)
Curculionidae	40 (12-74)
Libelluloidae nymphs	30 ( 6-66)
Trichoptera larvae	10 ( +-45)

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<sup>1</sup> Collected January 9-March 25. Percentage occurrence of foods that made up 5% or more of the volume in individual birds. Figures in parentheses show 95%

Table 106

LOCAL DISTRIBUTION OF HUNTING KILL OF RING-NECKED DUCKS<sup>1</sup>


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Upper Potomac Section	17%
Patuxent River Section	13
Susquehanna Flats Section	11
Upper Western Shore Section	10
Central Western Shore Section	10
Eastern Bay Section	8
Choptank River Section	7
Upper Eastern Shore Section	7
Central Potomac Section	5
Chester River Section	3
Lower Eastern Shore Section	3
Lower Potomac Section	3
Coastal Section	2
Blackwater-Nanticoke Section	1
Lower Western Shore Section	0
Total	100%

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<sup>1</sup> Based on 26 weighted band recoveries.



Table 107

HARVEST AREAS (INDIRECT RECOVERIES) OF RING-NECKED DUCKS Banded IN THE  
GIBSON ISLAND, CHESTER RIVER, AND BLACKWATER RIVER AREAS<sup>1</sup>

Mid-Atlantic States	<u>63%</u>
Delaware	3
Maryland	34
Virginia	16
North Carolina	11
Eastern Great Lakes-St. Lawrence Area	<u>18%</u>
New York	3
Quebec	8
Ontario	8
Southeastern States	<u>13%</u>
South Carolina	8
Florida	5
Prairie Provinces	<u>3%</u>
Manitoba	3
Bahama Islands	<u>3%</u>
TOTAL	100%

<sup>1</sup> 38 banded December 23-March 16, 1952-57.

Table 108

ECOLOGICAL DISTRIBUTION OF CANVASBACKS DURING THE 1958-59 SEASON

	Nov.3-12, 1958	Dec.1-12, 1958	Jan.7-13, 1959	Mar.3-16, 1959
Fresh Estuarine Bays	92%	18%	1%	22%
Slightly Brackish Estuarine Bays	2%	20%	14%	12%
Brackish Estuarine Bays	6%	55%	50%	57%
Salt Estuarine Bays	0	4%	27%	5%
Coastal Impoundment - Bay Complex	0	3%	8%	4%
Total Populations	40,900	105,500	105,800	78,400

Table 109

BIOGEOGRAPHICAL DISTRIBUTION OF CANVASBACKS DURING  
THE WINTERS OF 1955-58

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Eastern Bay Section	20%
Central Potomac Section	13
Choptank River Section	12
Chester River Section	12
Blackwater-Nanticoke Section	11
Central Western Shore Section	7
Patuxent River Section	7
Coastal Section	5
Upper Eastern Shore Section	5
Upper Western Shore Section	3
Lower Eastern Shore Section	2
Susquehanna Flats Section	2
Lower Potomac Section	2
Upper Potomac Section	1
Lower Western Shore Section	+
Total	100%

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Table 110

## BIOGEOGRAPHICAL DISTRIBUTION OF CANVASBACKS DURING THE 1958-59 SEASON

	Nov.3-12, 1958	Dec.1-12, 1958	Jan.7-13, 1959	Mar.3-16, 1959
Susquehanna Flats	<u>83%</u>	<u>3%</u>	<u>4%</u>	<u>14%</u>
Choptank River Section	<u>0</u>	<u>13%</u>	<u>20%</u>	<u>22%</u>
Central Choptank	(0)	(13)	(10)	(2)
Lower Choptank (North Shore)	(0)	( 0)	( 7)	(12)
Little Choptank	(0)	( +)	( 2)	( 6)
Chester River Section	<u>6%</u>	<u>27%</u>	<u>8%</u>	<u>6%</u>
Central Chester River	(6)	(26)	( 8)	( 5)
Central Potomac Section	<u>2%</u>	<u>18%</u>	<u>13%</u>	<u>9%</u>
Upper Western Shore Section	<u>9%</u>	<u>17%</u>	<u>1%</u>	<u>4%</u>
Spesutie Island-Pooles Island Area	(9)	(15)	( +)	( 1)
Eastern Bay Section	<u>0</u>	<u>4%</u>	<u>14%</u>	<u>15%</u>
Upper Eastern Bay	(0)	( 0)	(10)	( 6)
Lower Western Shore Section	<u>0</u>	<u>4%</u>	<u>24%</u>	<u>0</u>
Calvert County Shore	(0)	( +)	(24)	( 0)
Coastal Section	<u>0</u>	<u>3%</u>	<u>8%</u>	<u>4%</u>
Central Western Shore Section	<u>0</u>	<u>7%</u>	<u>3%</u>	<u>4%</u>
Lower Potomac Section	<u>0</u>	<u>1%</u>	<u>6%</u>	<u>6%</u>
Blackwater-Nanticoke Section	<u>0</u>	<u>5%</u>	<u>4%</u>	<u>6%</u>
Lower Eastern Shore Section	<u>0</u>	<u>4%</u>	<u>1%</u>	<u>3%</u>
Patuxent River Section	<u>0</u>	<u>2%</u>	<u>1%</u>	<u>1%</u>
Upper Eastern Shore Section	<u>0</u>	<u>4%</u>	<u>0</u>	<u>4%</u>
Upper Potomac Section	<u>0</u>	<u>4%</u>	<u>4%</u>	<u>3%</u>
Total Populations	40,900	105,500	105,800	78,400

Table 111

FOODS OF 30 CANVASBACKS FROM FRESH ESTUARINE BAYS OF THE  
SUSQUEHANNA FLATS, AND GUNPOWDER AND SASSAFRAS RIVERS<sup>1</sup>


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Leaves, Stems and Rootstalks of Submerged Aquatic Plants	<u>90%</u> (73-98)
Wildcelery	70 (50-86)
Sago Pondweed	17 ( 5-35)
Naiad	3 ( +-18)
Rootstalks of Emergent Marsh Plants	<u>3%</u> ( +-18)
Arrowhead	3 ( +-18)
Seeds	<u>47%</u> (28-66)
Sago Pondweed	20 ( 7-39)
Claspingleaf Pondweed	20 ( 7-39)
Pondweed	7 ( +-23)
Animal Food	<u>3%</u> ( +-18)
Ephemeroptera larvae	3 ( +-18)

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<sup>1</sup> Collected November-March. Percentage occurrence of foods that made up 5% or more of the volume in individual birds. Figures in parentheses show 95% confidence limits.

Table 112

FOODS OF 41 CANVASBACKS FROM BRACKISH ESTUARINE BAYS OF THE  
CHESTER RIVER, EASTERN BAY, AND CHOPTANK RIVER<sup>1</sup>

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Leaves, Stems and Rootstalks of Submerged Aquatic Plants	<u>56%</u> (39-72)
Claspingleaf Pondweed	46 (30-63)
Eelgrass	22 (10-38)
Widgeongrass	10 ( 2-24)
Seeds	<u>37%</u> (22-54)
Claspingleaf Pondweed	32 (18-49)
Widgeongrass	17 ( 7-33)
Sago Pondweed	2 ( +-13)
Giant Burreed	2 ( +-13)
Grain (bait)	<u>24%</u> (12-41)
Corn	24 (12-41)
Wheat	2 ( +-13)
Animal Food	<u>80%</u> (65-92)
<u>Macoma balthica</u> (Pelecypoda)	56 (39-72)
Xanthidae	24 (12-41)
<u>Callinectes sapidus</u> (Decapoda)	20 ( 8-35)
<u>Mulinia lateralis</u> (Pelecypoda)	17 ( 7-33)
<u>Gemma gemma</u> (Pelecypoda)	7 ( 1-20)
<u>Bittium varium</u> (Gastropoda)	7 ( 1-20)
<u>Mya arenaria</u> (Pelecypoda)	7 ( 1-20)
<u>Erichsonella</u> sp. (Isopoda)	7 ( 1-20)
<u>Laevicardium mortoni</u> (Pelecypoda)	2 ( +-13)
<u>Macoma phenax</u> (Pelecypoda)	2 ( +-13)

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Table 112 (continued)

## Animal Food--cont.

<u>Nassarius trivittatus</u> (Gastropoda)	2% (+-13)
<u>Triphora perversa</u> (Gastropoda)	2 (+-13)
<u>Odostomia impressa</u> (Gastropoda)	2 (+-13)
<u>Brachidontes recurvus</u> (Pelecypoda)	2 (+-13)
Polychaeta	2 (+-13)
<u>Ovalipes ocellatus</u> (Decapoda)	2 (+-13)
Decapoda (sp. ?)	2 (+-13)
Mollusca (sp. ?)	2 (+-13)

<sup>1</sup> Collected November-February. Percentage occurrence of foods that made up 5% or more of the volume in individual birds. Figures in parentheses show 95% confidence limits.

Table 113

FOODS OF 9 CANVASBACKS FROM TURBID BRACKISH ESTUARINE BAYS  
OF FISHING BAY AND THE NANTICOKE RIVER<sup>1</sup>

Leaves, Stems and Rootstalks of Submerged Aquatic Plants	22% (2-61)
Eelgrass	11 (+-49)
Widgeongrass	11 (+-49)
Grain	33% (7-71)
Corn (bait)	33 (7-71)
Animal Food	100% (66-100)
<u>Macoma balthica</u> (Pelecypoda)	78 (39-98)
Mollusca (sp. ?)	22 (2-61)
<u>Mulinia lateralis</u> (Pelecypoda)	11 (+-49)
<u>Sayella chesapeakea</u> (Gastropoda)	11 (+-49)
Xanthidae	11 (+-49)
<u>Cyathura</u> sp. (Isopoda)	11 (+-49)

<sup>1</sup> Collected October-March. Percentage occurrence of foods that made up 5% or more of the volume in individual birds. Figures in parentheses show 95% confidence limits.

Table 114

FOODS OF 6 CANVASBACKS FROM SALT ESTUARINE BAYS OF DORCHESTER  
COUNTY, MARYLAND AND SAXIS ISLAND, VIRGINIA<sup>1</sup>

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Leaves, Stems and Rootstalks of Submerged Aquatic Plants	<u>17%</u> (+-65)
Eelgrass	17 (+-65)
Grain (bait)	<u>67%</u> (22-96)
Corn	67 (22-96)
Wheat	17 ( +-65)
Animal Food	<u>83%</u> (35-100)
Undetermined Mollusks	50 (11-89)
<u>Macoma balthica</u> (Pelecypoda)	33 ( 4-78)
<u>Congeria leucophaeta</u> (Pelecypoda)	17 ( +-65)
<u>Mulinia lateralis</u> (Pelecypoda)	17 ( +-65)
<u>Mactra</u> sp. (Pelecypoda)	17 ( +-65)
<u>Acteocina canaliculata</u> (Gastropoda)	17 ( +-65)
<u>Bittium varium</u> (Gastropoda)	17 ( +-65)
<u>Sayella chesapeakea</u> (Gastropoda)	17 ( +-65)
<u>Callinectes sapidus</u> (Decapoda)	17 ( +-65)
Polychaeta	17 ( +-65)

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<sup>1</sup> Collected November-January. Percentage occurrence of foods that made up 5% or more of the volume in individual birds. Figures in parentheses show 95% confidence limits.

Table 115

LOCAL DISTRIBUTION OF HUNTING KILL OF CANVASBACKS<sup>1</sup>

Chester River Section	19%
Choptank River Section	11
Central Potomac Section	9
Susquehanna Flats Section	9
Eastern Bay Section	8
Lower Eastern Shore Section	8
Upper Western Shore Section	7
Central Western Shore Section	5
Upper Eastern Shore Section	5
Patuxent River Section	4
Blackwater-Nanticoke Section	4
Lower Potomac Section	4
Coastal Section	3
Upper Potomac Section	3
Lower Western Shore Section	1
Coastal Plain Interior	+
Total	100%

<sup>1</sup> Based on 370 weighted band recoveries.



Table 116

HARVEST AREAS OF CANVASBACKS BANDED IN THE UPPER CHESAPEAKE REGION<sup>1</sup>

Area of Recovery	Distribution of Indirect Recoveries		
	132 Recoveries Winter-banded Jan.23-Feb.20, 1955-58	206 Recoveries Spring-banded Feb.21-April 4, 1955-58	Total 338 Recoveries Banded 1955-58
Mid-Atlantic States	<u>56%</u>	<u>66%</u>	<u>62%</u>
New Jersey	1	3	2
Pennsylvania	1	1	1
Maryland	48	58	54
Virginia	4	3	3
North Carolina	2	1	1
Eastern Great Lakes Area	<u>8%</u>	<u>3%</u>	<u>5%</u>
New York	2	1	1
Ontario	5	+	2
Michigan	1	2	1
North-Central States	<u>26%</u>	<u>21%</u>	<u>23%</u>
Wisconsin	4	6	5
Minnesota	14	8	10
South Dakota	3	1	2
North Dakota	5	6	6
Prairie Provinces	<u>7%</u>	<u>7%</u>	<u>7%</u>
Manitoba	6	4	5
Other (Alta., Sask.)	1	2	2

Table 116 (continued)

Area of Recovery	<u>Distribution of Indirect Recoveries</u>		
	132 Recoveries Winter-banded Jan.23-Feb.20, 1955-58	206 Recoveries Spring-banded Feb.21-April 4, 1955-58	Total 338 Recoveries Banded 1955-58
Western States (Idaho,Mont., Ore.,Utah,Wash.)	<u>2%</u>	<u>1%</u>	<u>2%</u>
Mid-Western States (Ill.,Ind.)	<u>2%</u>	<u>0</u>	<u>1%</u>
South-Central States (Texas)	<u>0</u>	<u>+</u>	<u>+</u>
Southeastern States (Florida)	<u>0</u>	<u>+</u>	<u>+</u>
TOTAL	100%	100%	100%

<sup>1</sup> Banding stations located in the Chester River-Eastern Bay, Choptank River, Hooper Island, Gibson Island, Sandy Point (Anne Arundel Co.), and Solomons Areas.

Table 117

FOODS OF 15 GREATER SCAUP FROM SALT ESTUARINE BAYS IN THE TAYLOR ISLAND, HOLLAND ISLAND, SMITH ISLAND, AND SAXIS ISLAND AREAS<sup>1</sup>


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Leaves, Stems and Rootstalks of Submerged Aquatic Plants	47% (21-74)
Eelgrass	47 (21-74)
Widgeongrass	7 (1-41)
Grain	27% (7-56)
Corn (bait)	27 (7-56)
Animal Food	93% (68-100)
<u>Bittium varium</u> (Gastropoda)	53 (26- 79)
<u>Mitrella lunata</u> (Gastropoda)	53 (26- 79)
<u>Nassarius trivittatus</u> (Gastropoda)	33 (11- 62)
<u>Anachis avara</u> (Gastropoda)	27 (7- 56)
Undetermined Mollusks	27 (7- 56)
<u>Macoma balthica</u> (Pelecypoda)	20 (4- 49)
<u>Laevicardium murtoni</u> (Pelecypoda)	13 (1- 41)
<u>Acteocina canaliculata</u> (Gastropoda)	13 (1- 41)
<u>Ilyanassa obsoleta</u> (Gastropoda)	13 (1- 41)
<u>Clathurella jewetti</u> (Gastropoda)	13 (1- 41)
<u>Gemma gemma</u> (Pelecypoda)	7 (+- 32)
<u>Odostomia impressa</u> (Gastropoda)	7 (+- 32)
<u>Cerithiopsis subulata</u> (Gastropoda)	7 (+- 32)
<u>Turbonilla</u> sp. (Gastropoda)	7 (+- 32)
<u>Pyramidella</u> sp. (Gastropoda)	7 (+- 32)
<u>Pleurotoma</u> sp. (Gastropoda)	7 (+- 32)

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<sup>1</sup> Collected November-January. Percentage occurrence of foods that made up 5% or more of the volume in individual birds. Figures in parentheses show 95% confidence limits.

Table 118

FOODS OF 9 GREATER SCAUP FROM BRACKISH ESTUARINE BAYS OF  
THE CHOPTANK RIVER, EASTERN BAY, AND CHESTER RIVER<sup>1</sup>

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Leaves, Stems and Rootstalks of Submerged Aquatic Plants	<u>33%</u> (7-71)
Eelgrass	22 (2-61)
Zosteraceae (sp.?)	11 (+-49)
Grain (bait)	<u>22%</u> (2-61)
Corn	22 (2-61)
Seeds	<u>22%</u> (2-61)
Widgeongrass	22 (2-61)
Animal Food	<u>100%</u> (66-100)
<u>Mulinia lateralis</u> (Pelecypoda)	44 (13-79)
<u>Brachidontes recurvus</u> (Pelecypoda)	22 (2-61)
<u>Bittium varium</u> (Gastropoda)	22 (2-61)
<u>Macoma balthica</u> (Pelecypoda)	11 (+-49)
<u>Odostomia impressa</u> (Gastropoda)	11 (+-49)
<u>Ilyanassa obsoleta</u> (Gastropoda)	11 (+-49)
<u>Laevicardium mortoni</u> (Pelecypoda)	11 (+-49)

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<sup>1</sup> Collected November-January. Percentage occurrence of foods that made up 5% or more of the volume in individual birds. Figures in parentheses show 95% confidence limits.

Table 119

FOODS OF 19 GREATER SCAUP FROM FRESH ESTUARINE BAYS OF THE  
SUSQUEHANNA FLATS, AND GUNPOWDER AND POTOMAC RIVERS<sup>1</sup>

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Leaves, Stems and Rootstalks of	
Submerged Aquatic Plants	<u>84%</u> (60-97)
Wildcelery	74 (48-91)
Pondweed	11 ( 1-34)
Muskgrass	5 ( +-26)
Seeds	<u>42%</u> (20-67)
Pondweed	32 (12-57)
Sago Pondweed	5 ( +-26)
Widgeongrass	5 ( +-26)
Animal Food	<u>74%</u> (48-91)
Gastropoda (sp.?)	37 (16-62)
<u>Oxytrema virginica</u> (Gastropoda)	26 ( 9-52)
<u>Ammicola limosa</u> (Gastropoda)	11 ( 1-34)
<u>Gemma gemma</u> (Pelecypoda)	5 ( +-26)
Amphipoda	5 ( +-26)

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<sup>1</sup> Collected November and late February. Percentage occurrence of foods that made up 5% or more of the volume in individual birds. Figures in parentheses show 95% confidence limits.

Table 120

HARVEST AREAS (INDIRECT RECOVERIES) OF GREATER SCAUP BANDED IN  
THE UPPER CHESAPEAKE REGION<sup>1</sup>

Coastal Area	<u>81%</u>
New York	5
New Jersey	11
Maryland	51
Virginia	11
North Carolina	3
Great Lakes-St. Lawrence Area	<u>19%</u>
Quebec	11
Ontario	3
Michigan	3
Wisconsin	3
TOTAL	100%

<sup>1</sup> 37 banded in the Chester River-Eastern Bay area, at Solomons, and at Sandy Point in Anne Arundel County, during January 29-May 4, 1954-58.

Table 121

ECOLOGICAL DISTRIBUTION OF SCAUP (Both Species Combined)  
DURING THE 1958-59 SEASON

	Nov. 3-12 1958	Dec. 1-12 1958	Jan. 7-13 1959	Mar. 3-16 1959
Fresh Estuarine Bays	71%	6%	0	22%
Slightly Brackish Estuarine Bays	0	21%	2%	8%
Brackish Estuarine Bays	29%	48%	26%	57%
Salt Estuarine Bays	0	24%	61%	13%
Coastal Bays	0	1%	11%	+
Total Populations	8,900	52,900	67,200	70,500

Table 122

BIOGEOGRAPHICAL DISTRIBUTION OF SCAUP (BOTH SPECIES)  
DURING THE WINTERS OF 1955-58

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Central Western Shore Section	24%
Patuxent River Section	23
Coastal Section	11
Eastern Bay Section	10
Chester River Section	6
Blackwater-Nanticoke Section	5
Lower Potomac Section	5
Lower Eastern Shore Section	4
Upper Western Shore Section	3
Central Potomac Section	3
Choptank River Section	2
Upper Eastern Shore Section	2
Lower Western Shore Section	1
Upper Potomac Section	+
Susquehanna Flats Section	0
Total	100%

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Table 123

BIOGEOGRAPHICAL DISTRIBUTION OF SCAUP (Both Species,  
Combined) DURING THE 1958-59 SEASON

	Nov.3-12, 1958	Dec.1-12, 1958	Jan.7-13, 1959	Mar.3-16, 1959
Lower Western Shore Section	<u>0</u>	<u>8%</u>	<u>56%</u>	<u>+%</u>
Calvert Co. Shore	(0)	(8)	(56)	(+)
Susquehanna Flats Section	<u>38%</u>	<u>+%</u>	<u>0</u>	<u>20%</u>
Chester River Section	<u>26%</u>	<u>15%</u>	<u>9%</u>	<u>3%</u>
Central Chester River	(26)	(7)	(9)	(3)
Upper Western Shore Section	<u>33%</u>	<u>12%</u>	<u>+%</u>	<u>4%</u>
Choptank River Section	<u>2%</u>	<u>19%</u>	<u>4%</u>	<u>11%</u>
Little Choptank	(2)	(8)	(4)	(7)
Central Choptank	(0)	(12)	(0)	(+)
Lower Eastern Shore Section	<u>0</u>	<u>15%</u>	<u>2%</u>	<u>9%</u>
Central Western Shore Section	<u>0</u>	<u>+%</u>	<u>0</u>	<u>20%</u>
Lower Potomac Section	<u>0</u>	<u>2%</u>	<u>7%</u>	<u>10%</u>
Central Potomac Section	<u>0</u>	<u>12%</u>	<u>2%</u>	<u>5%</u>
Eastern Bay Section	<u>1%</u>	<u>0</u>	<u>9%</u>	<u>5%</u>
Patuxent River Section	<u>0</u>	<u>10%</u>	<u>0</u>	<u>2%</u>
Blackwater-Nanticoke Section	<u>0</u>	<u>2%</u>	<u>0</u>	<u>10%</u>
Coastal Section	<u>0</u>	<u>1%</u>	<u>11%</u>	<u>+%</u>
Upper Eastern Shore Section	<u>0</u>	<u>2%</u>	<u>0</u>	<u>0</u>
Upper Potomac Section	<u>0</u>	<u>1%</u>	<u>0</u>	<u>1%</u>
Total Populations	8,900	52,900	67,200	70,500



Table 124

FOODS OF 22 LESSER SCAUP FROM FRESH ESTUARINE BAYS OF THE  
POTOMAC RIVER, GUNPOWDER RIVER, AND SUSQUEHANNA FLATS<sup>1</sup>


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Leaves, Stems and Rootstalks of Submerged Aquatic Plants	36% (17-60)
Claspingleaf Pondweed	14 ( 2-35)
Widgeongrass	14 ( 2-35)
Wildcelery	9 ( 1-30)
Naiad	9 ( 1-30)
Grassleaf Pondweed	9 ( 1-30)
Pondweed	9 ( 1-30)
Rootstalks of Emergent Marsh Plants	5% ( +-23)
Arrowhead	5 ( +-23)
Grain (bait)	18% ( 5-41)
Corn	18 ( 5-41)
Wheat	5 ( +-23)
Animal Food	77% (54-93)
<u>Oxytrema virginica</u> (Gastropoda)	36 (17-60)
Gastropoda (sp.?)	36 (17-60)
<u>Amnicola</u> sp. (Gastropoda)	23 ( 7-46)
<u>Gillia atilis</u> (Gastropoda)	14 ( 2-35)
Unionidae (sp.?)	14 ( 2-35)
Pelecypoda (sp.?)	14 ( 2-35)
<u>Planorbis</u> sp. (Gastropoda)	14 ( 2-35)
<u>Bittium</u> sp. (Gastropoda)	5 ( +-23)
Cladocera (sp.?)	5 ( +-23)
<u>Valvata tricarinata</u> (Gastropoda)	5 ( +-23)
Rissoidae (sp.?)	5 ( +-23)
<u>Sphaerium</u> sp. (Pelecypoda)	5 ( +-23)

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<sup>1</sup> Collected October-May. Percentage occurrence of foods that made up 5% or more of the volume in individual birds. Figures in parentheses show 95% confidence limits.

Table 125

FOODS OF 13 LESSER SCAUP FROM BRACKISH ESTUARINE BAYS OF THE  
CHOPTANK RIVER, EASTERN BAY, AND CHESTER RIVER<sup>1</sup>


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Leaves, Stems and Rootstalks of Submerged Aquatic Plants	<u>23%</u> ( 5-54)
Widgeongrass	8 ( +-37)
Claspingleaf Pondweed	8 ( +-37)
Eelgrass	8 ( +-37)
Seeds	<u>38%</u> (13-69)
Widgeongrass	31 ( 9-62)
Claspingleaf Pondweed	15 ( 1-46)
Sago Pondweed	8 ( +-37)
Grain (bait)	<u>54%</u> (25-81)
Corn	54 (25-81)
Wheat	8 ( +-37)
Animal Food	<u>77%</u> (46-95)
<u>Mulinia lateralis</u> (Pelecypoda)	38 (13-69)
<u>Brachidontes recurvus</u> (Pelecypoda)	23 ( 5-54)
<u>Gemma gemma</u> (Pelecypoda)	23 ( 5-54)
<u>Sayella chesapeakea</u> (Gastropoda)	15 ( 1-46)
<u>Macoma balthica</u> (Pelecypoda)	15 ( 1-46)
<u>Mya arenaria</u> (Pelecypoda)	15 ( 1-46)
Gammaridae (sp.?)	15 ( 1-46)
<u>Acteocina canaliculata</u> (Gastropoda)	8 ( +-37)
<u>Volselfa demissa</u> (Pelecypoda)	8 ( +-37)
Decapoda (sp.?)	8 ( +-37)

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<sup>1</sup> Collected November 28-March 18. Percentage occurrence of foods that made up 5% or more of the volume in individual birds. Figures in parentheses show 95% confidence limits.

Table 126

FOODS OF 14 LESSER SCAUP FROM TURBID BRACKISH ESTUARINE BAYS  
OF FISHING BAY AND THE NANTICOKE RIVER<sup>1</sup>

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Seeds	<u>7%</u> ( +-34)
Olney Three-square	7 ( +-34)
Grain (bait)	<u>14%</u> ( 1-43)
Corn	14 ( 1-43)
Animal Food	<u>100%</u> (76-100)
<u>Acteocina canaliculata</u> (Gastropoda)	64 (35-88)
<u>Mulinia lateralis</u> (Pelecypoda)	50 (23-77)
<u>Laevicardium mortoni</u> (Pelecypoda)	36 (12-65)
<u>Macoma balthica</u> (Pelecypoda)	36 (12-65)
<u>Chiridotea coeca</u> (Isopoda)	36 (12-65)
<u>Brachidontes recurvus</u> (Pelecypoda)	29 ( 8-59)
<u>Odostomia impressa</u> (Gastropoda)	21 ( 4-51)
<u>Triphora perversa</u> (Gastropoda)	14 ( 1-43)
Gammaridae (sp.?)	14 ( 1-43)
<u>Sayella chesapeakea</u> (Gastropoda)	7 ( +-34)
<u>Mya arenaria</u> (Pelecypoda)	7 ( +-34)
<u>Nassarius trivittatus</u> (Gastropoda)	7 ( +-34)
<u>Bittium varium</u> (Gastropoda)	7 ( +-34)
<u>Macoma phenax</u> (Pelecypoda)	7 ( +-34)
<u>VolSELLA demissa</u> (Pelecypoda)	7 ( +-34)
Decapoda (sp.?)	7 ( +-34)

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<sup>1</sup> Collected January 9-March 23. Percentage occurrence of foods that made up 5% or more of the volume in individual birds. Figures in parentheses show 95% confidence limits.

Table 127

FOODS OF 7 LESSER SCAUP FROM SALT ESTUARINE BAYS OF DORCHESTER COUNTY<sup>1</sup>


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Leaves, Stems and Rootstalks of Submerged Aquatic Plants	<u>43%</u> ( 9-82)
Eelgrass	43 ( 9-82)
Seeds	<u>14%</u> ( +-58)
Widgeongrass	14 ( +-58)
Olney Three-square	14 ( +-58)
Grain (bait)	<u>57%</u> (18-91)
Corn	57 (18-91)
Animal Food	<u>100%</u> (59-100)
<u>Bittium</u> sp. (Gastropoda)	57 (18-91)
<u>Mitrella lunata</u> (Gastropoda)	14 ( +-58)
<u>Mulinia lateralis</u> (Pelecypoda)	14 ( +-58)
<u>Odostomia impressa</u> (Gastropoda)	14 ( +-58)
<u>Ilyanassa obsoleta</u> (Gastropoda)	14 ( +-58)
<u>Gemma gemma</u> (Pelecypoda)	14 ( +-58)
<u>Triphora perversa</u> (Gastropoda)	14 ( +-58)
<u>Acteocina canaliculata</u> (Gastropoda)	14 ( +-58)
Rissoidae (sp.?)	14 ( +-58)
Pelecypoda (sp.?)	14 ( +-58)
Gammaridae (sp.?)	14 ( +-58)

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<sup>1</sup> Collected November 18-February 19. Percentage occurrence of foods that made up 5% or more of the volume in individual birds. Figures in parentheses show 95% confidence limits.

Table 128

FOODS OF 5 LESSER SCAUP FROM INTERIOR IMPOUNDMENTS IN PRINCE GEORGES COUNTY<sup>1</sup>

Seeds	<u>100%</u> (47-100)
Common Burreed	60 (14- 95)
Squarestem Spikerush	20 ( +- 72)
Swamp Rose	20 ( +- 72)
Berchtold Pondweed	20 ( +- 72)
Animal Food	<u>100%</u> (47-100)
Libelluloidea nymphs	80 (28-100)
Curculionidae (sp.?)	60 (14- 95)
<u>Acteocina canaliculata</u> (Gastropoda)	20 ( +- 72)
Hydrachnellae	20 ( +- 72)
Fish (Centrarchidae)	20 ( +- 72)
Gyrinidae larvae	20 ( +- 72)

<sup>1</sup> Collected March-April. Percentage occurrence of foods that made up 5% or more of the volume in individual birds. Figures in parentheses show 95% confidence limits.

Table 129

LOCAL DISTRIBUTION OF HUNTING KILL OF LESSER SCAUP<sup>1</sup>


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Chester River Section	17%
Upper Western Shore Section	11
Lower Potomac Section	11
Central Western Shore Section	10
Central Potomac Section	7
Lower Eastern Shore Section	7
Susquehanna Flats	6
Choptank River Section	6
Upper Potomac Section	5
Blackwater-Nanticoke Section	5
Eastern Bay Section	4
Patuxent River Section	4
Coastal Section	4
Upper Eastern Shore Section	3
Lower Western Shore Section	+
Total	100%

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<sup>1</sup> Based on 180 weighted band recoveries.

Table 130

HARVEST AREAS OF LESSER SCAUP Banded IN THE UPPER CHESAPEAKE REGION<sup>1</sup>

<u>Area of Recovery</u>	<u>Distribution of Indirect Recoveries</u>		
	121 Recoveries Winter-banded Jan. 24-Feb. 20, 1952-57	311 Recoveries Spring-banded Feb. 21-Apr. 3, 1954-58	Total 432 Recoveries Banded -- 1952-58
Mid-Atlantic States	<u>72%</u>	<u>72%</u>	<u>52%</u>
Maryland	48	54	72
Virginia	17	13	14
North Carolina	7	5	5
Other (N.J., Penn.)	1	1	1
Eastern Great Lakes - St. Lawrence	<u>11%</u>	<u>8%</u>	<u>9%</u>
Ontario	5	2	3
Michigan	2	3	3
Ohio	3	1	2
Other (N.Y., Que.)	0	2	1
North-Central States	<u>5%</u>	<u>7%</u>	<u>6%</u>
Wisconsin	2	3	2
Minnesota	2	3	3
Other (N.D., S.D.)	1	1	1
Prairie Provinces	<u>5%</u>	<u>5%</u>	<u>5%</u>
Manitoba	4	4	4
Other (Alta., Sask.)	1	1	1
Southeastern States (Ala., Fla., Ga., S.C.)	<u>3%</u>	<u>4%</u>	<u>4%</u>

Table 130 (continued)

<u>Area of Recovery</u>	<u>Distribution of Indirect Recoveries</u>		
	121 Recoveries Winter-banded Jan.24-Feb.20, 1952-57	211 Recoveries Spring-banded Feb.21-Apr. 3, 1954-58	Total 432 Recoveries Banded -- 1952-58
South-Central States (La., Tenn., Tex.)	<u>2%</u>	<u>2%</u>	<u>2%</u>
Mid-Western States (Ill., Ia.)	<u>2%</u>	<u>1%</u>	<u>1%</u>
Northwest Territories	<u>1%</u>	<u>1%</u>	<u>1%</u>
Northeastern (Conn., N.B.)	<u>0</u>	<u>1%</u>	<u>4%</u>
TOTAL	100%	100%	100%

<sup>1</sup> Banding stations located in the Chester River, Eastern Bay, Choptank River, Hooper Island, Gibson Island, Solomons, and Smiths Creek (St. Marys Co.,) Areas.

Table 131

ECOLOGICAL DISTRIBUTION OF COMMON GOLDENEYES AND BUFFLEHEADS  
DURING THE 1958-59 SEASON

	Nov.3-12, 1958	Dec.1-12, 1958	Jan.7-13, 1959	Mar.3-16, 1959
Fresh Estuarine Bays	30%	10%	4%	9%
Slightly Brackish Estuarine Bays	21%	13%	20%	3%
Brackish Estuarine Bays	20%	45%	49%	62%
Salt Estuarine Bays	27%	28%	23%	22%
Coastal Bays	2%	4%	4%	4%
Total Populations	2,700	19,200	29,100	19,300



Table 132

BIOGEOGRAPHICAL DISTRIBUTION OF COMMON GOLDENEYES AND  
BUFFLEHEADS DURING THE WINTERS OF 1955-58

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Choptank River Section	18%
Eastern Bay Section	17
Lower Eastern Shore Section	12
Coastal Section	9
Blackwater-Nanticoke Section	9
Upper Potomac Section	8
Central Western Shore Section	7
Patuxent River Section	6
Susquehanna Flats Section	5
Lower Potomac Section	3
Central Potomac Section	3
Chester River Section	2
Upper Eastern Shore Section	1
Upper Western Shore Section	+
Lower Western Shore Section	0
Total	100%

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Table 133

BIOGEOGRAPHICAL DISTRIBUTION OF COMMON GOLDENEYES  
AND BUFFLEHEADS DURING THE 1958-59 SEASON

	Nov. 3-12, 1958	Dec. 1-12, 1958	Jan. 7-13, 1959	Mar. 3-16, 1959
Lower Eastern Shore Section	<u>27%</u>	<u>24%</u>	<u>11%</u>	<u>12%</u>
Choptank River Section	<u>12%</u>	<u>13%</u>	<u>14%</u>	<u>24%</u>
Eastern Bay Section	<u>5%</u>	<u>17%</u>	<u>17%</u>	<u>17%</u>
Central Potomac Section	<u>20%</u>	<u>11%</u>	<u>18%</u>	<u>2%</u>
Susquehanna Flats Section	<u>21%</u>	<u>4%</u>	<u>2%</u>	<u>7%</u>
Lower Potomac Section	<u>0</u>	<u>9%</u>	<u>9%</u>	<u>9%</u>
Chester River Section	<u>3%</u>	<u>4%</u>	<u>9%</u>	<u>7%</u>
Upper Western Shore Section	<u>10%</u>	<u>2%</u>	<u>4%</u>	<u>1%</u>
Lower Western Shore Section	<u>0</u>	<u>0</u>	<u>8%</u>	<u>6%</u>
Coastal Section	<u>2%</u>	<u>4%</u>	<u>4%</u>	<u>4%</u>
Central Western Shore Section	<u>0</u>	<u>2%</u>	<u>2%</u>	<u>5%</u>
Patuxent River Section	<u>+%</u>	<u>2%</u>	<u>1%</u>	<u>4%</u>
Upper Potomac Section	<u>+%</u>	<u>5%</u>	<u>+%</u>	<u>1%</u>
Blackwater-Nanticoke Section	<u>+%</u>	<u>2%</u>	<u>1%</u>	<u>+%</u>
Upper Eastern Shore Section	<u>0</u>	<u>1%</u>	<u>0</u>	<u>1%</u>
Total Populations	2,700	19,200	29,100	19,300

Table 134

FOODS OF 6 COMMON GOLDENEYES FROM FRESH ESTUARINE BAYS OF  
THE POTOMAC RIVER<sup>1</sup>

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Leaves, Stems and Rootstalks of Submerged Aquatic Plants	<u>67%</u> (22-96)
Pondweed	33 (4-78)
Sago Pondweed	17 (+-65)
Wildcelery	17 (+-65)
Seeds	<u>33%</u> (4-78)
Naiad	17 (+-65)
Sago Pondweed	17 (+-65)
Pondweed	17 (+-65)
Animal Food	<u>67%</u> (22-96)
Gastropoda (sp.?)	33 (4-78)
<u>Oxytrema virginica</u> (Gastropoda)	17 (+-65)
Unionidae (sp.?)	17 (+-65)
Mollusca (sp.?)	17 (+-65)
Decapoda (sp.?)	17 (+-65)
Fish (sp.?)	17 (+-65)
Trichoptera larvae	17 (+-65)
Odonata larvae	17 (+-65)

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<sup>1</sup> Collected November-March. Percentage occurrence of foods that made up 5% or more of the volume in individual birds. Figures in parentheses show 95% confidence limits.

Table 135

FOODS OF 7 COMMON GOLDENEYES FROM BRACKISH ESTUARINE  
BAYS OF EASTERN BAY AND THE CHOPTANK RIVER<sup>1</sup>

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Leaves, Stems and Rootstalks of Submerged Aquatic Plants	<u>29%</u> ( 3-71)
Eelgrass	14 ( +-58)
Widgeongrass	14 ( +-58)
Grain (bait)	<u>29%</u> ( 3-71)
Corn	29 ( 3-71)
Animal Food	<u>100%</u> (59-100)
Xanthidae	43 ( 9- 82)
Fish (sp.?)	43 ( 9- 82)
<u>Volselfa demissa</u> (Pelecypoda)	43 ( 9- 82)
<u>Acteocina canaliculata</u> (Gastropoda)	14 ( +-58)
<u>Macoma balthica</u> (Pelecypoda)	14 ( +-58)
Gammaridae (Amphipoda)	14 ( +-58)
<u>Sesarma</u> sp. (Decapoda)	14 ( +-58)
Isopoda (sp.?)	14 ( +-58)
Pelecypoda (sp.?)	14 ( +-58)

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<sup>1</sup> Collected November-January. Percentage occurrence of foods that made up 5% or more of the volume in individual birds. Figures in parentheses show 95% confidence limits.

Table 136

FOODS OF 10 COMMON GOLDENEYES FROM SALT ESTUARINE BAYS OF THE HONGA RIVER,  
TANGIER SOUND, AND POCOMOKE SOUND AREAS<sup>1</sup>

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Grain (bait)	<u>70%</u> (34-94)
Corn	70 (34-94)
Animal Food	<u>90%</u> (55-100)
Xanthidae	40 (12-74)
<u>Brachidontes recurvus</u> (Pelecypoda)	30 ( 6-66)
<u>Mulinia lateralis</u> (Pelecypoda)	20 ( 2-56)
Pelecypoda (sp.?)	20 ( 2-56)
Gammaridae	20 ( 2-56)
<u>Macoma balthica</u> (Pelecypoda)	10 ( +-45)
<u>Ilyanassa obsoleta</u> (Gastropoda)	10 ( +-45)
Veneridae	10 ( +-45)
Isopoda	10 ( +-45)

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<sup>1</sup> Collected November-January. Percentage occurrence of foods that made up 5% or more of the volume in individual birds. Figures in parentheses show 95% confidence limits.

Table 137

FOODS OF 18 BUFFLEHEADS FROM BRACKISH ESTUARINE BAYS OF THE  
CHESTER RIVER, EASTERN BAY, AND CHOPTANK RIVER<sup>1</sup>

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Leaves, Stems and Rootstalks of Submerged Aquatic Plants	22% (6-48)
Widgeongrass	22 (6-48)
Eelgrass	11 (1-35)
Seeds	22 % (6-48)
Widgeongrass	17 (3-42)
Claspingleaf Pondweed	17 (3-42)
Grain (bait)	22% (6-48)
Corn	22 (6-48)
Animal Food	89% (65-99)
<u>Macoma balthica</u> (Pelecypoda)	22 (6-48)
<u>Balanus</u> sp. (Thoracica)	22 ( 6-48)
Xanthidae	22 (6-48)
<u>Gemma gemma</u> (Pelecypoda)	17 (3-42)
<u>Macoma phenax</u> (Pelecypoda)	11 (1-35)
<u>Mulinia lateralis</u> (Pelecypoda)	11 (1-35)
<u>Odostomia impressa</u> (Gastropoda)	11 (1-35)
Mytilidae	11 (1-35)
Gammaridae	11 (1-35)
Fish (sp.?)	11 (1-35)
<u>Erichsonella</u> sp. (Isopoda)	11 (1-35)

Table 137 (continued)

## Animal Food (cont)

<u>Brachidontes recurvus</u> (Pelecypoda)	6% (+-28)
<u>Mya arenaria</u> (Pelecypoda)	6 (+-28)
<u>Cyathura</u> sp. (Isopoda)	6 (+-28)
<u>Nereis</u> sp. (Annelida)	6 (+-28)
Crustacea (sp.?)	6 (+-28)
Myriapoda	6 (+-28)

<sup>1</sup> Collected November-January. Percentage occurrence of foods that made up 5% or more of the volume in individual birds. Figures in parentheses show 95% confidence limits.

Table 138

FOODS OF 4 BUFFLEHEADS FROM SALT ESTUARINE BAYS NEAR  
DEAL ISLAND AND SAXIS ISLAND<sup>1</sup>

Animal Food	100% (39-100)
<u>Mulinia lateralis</u> (Pelecypoda)	50 ( 6- 94)
<u>Macoma balthica</u> (Pelecypoda)	50 ( 6- 94)
Gammaridae	50 ( 6- 94)
<u>Acteocina canaliculata</u> (Gastropoda)	25 ( +- 81)
<u>Gemma gemma</u> (Pelecypoda)	25 ( +- 81)
<u>Nassarius trivittatus</u> (Gastropoda)	25 ( +- 81)
<u>Odostomia impressa</u> (Gastropoda)	25 ( +- 81)
<u>Lora</u> sp. (Gastropoda)	25 ( +-81 )
Xanthidae	25 ( +- 81)

<sup>1</sup> Collected November-January. Percentage occurrence of foods that made up 5% or more of the volume in individual birds. Figures in parentheses show 95% confidence limits.

Table 139

HARVEST AREAS (INDIRECT RECOVERIES) OF BUFFLEHEADS BANDED  
IN THE KENT ISLAND AREA<sup>1</sup>

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Mid-Atlantic States	<u>69%</u>
Maryland	66
Virginia	3
Eastern Great Lakes Area	<u>10%</u>
Ontario	3
Michigan	7
North-Central States	<u>14%</u>
Wisconsin	7
Minnesota	7
Prairie Provinces	<u>7%</u>
Saskatchewan	7
TOTAL	100%

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<sup>1</sup> 29 banded Jan. 23-Mar. 30, 1953-58.



Table 140

FOODS OF 6 OLDSQUAWS FROM BRACKISH ESTUARINE BAYS OF EASTERN BAY, AND THE CHOPTANK AND PATUXENT RIVERS<sup>1</sup>


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Leaves, Stems and Rootstalks of Submerged Aquatic Plants	<u>50%</u> (11-89)
Eelgrass	33 ( 4-78)
Widgeongrass	17 ( +-65)
Grain (bait)	<u>17%</u> ( +-65)
Wheat	17 ( +-65)
Corn	17 ( +-65)
Animal Food	<u>100%</u> (54-100)
Decapoda (sp.?)	50 (11-89)
Pelecypoda (sp.?)	33 ( 4-78)
Balanidae (sp.?)	33 ( 4-78)
Fish (sp.?)	33 ( 4-78)
<u>Neopanope texana</u> (Decapoda)	17 ( +-65)
<u>Gemma gemma</u> (Pelecypoda)	17 ( +-65)
<u>Brachidontes recurvus</u> (Pelecypoda)	17 ( +-65)
<u>Nereis</u> sp. (Annelida)	17 ( +-65)
<u>Erichsonella</u> sp. (Isopoda)	17 ( +-65)
Tunicata (sp.?)	17 ( +-65)
Amphipoda (sp.?)	17 ( +-65)
Crustacea (sp.?)	17 ( +-65)

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<sup>1</sup> Collected November-January. Percentage occurrence of foods that made up 5% or more of the volume in individual birds. Figures in parentheses show 95% confidence limits.

Table 141

## ECOLOGICAL DISTRIBUTION OF RUDDY DUCKS DURING THE 1958-59 SEASON

	Nov.3-12, 1958	Dec.1-12, 1958	Jan.7-13, 1959	Mar.3-16, 1959
Fresh Estuarine Bays	22%	12%	0	14%
Slightly Brackish Estuarine Bays	67%	58%	68%	56%
Brackish Estuarine Bays	11%	23%	4%	29%
Salt Estuarine Bays	+	7%	28%	1%
Total Populations	61,600	53,000	18,200	30,300

Table 142

## BIOGEOGRAPHICAL DISTRIBUTION OF RUDDY DUCKS DURING THE WINTERS OF 1955-58

Upper Western Shore Section	38%
Lower Potomac Section	24
Central Potomac Section	17
Blackwater-Nanticoke Section	7
Patuxent River Section	4
Central Western Shore Section	4
Chester River Section	3
Eastern Bay Section	2
Choptank River Section	1
Lower Eastern Shore Section	1
Upper Eastern Shore Section	+
Upper Potomac Section	+
Susquehanna Flats Section	0
Lower Western Shore Section	0
Coastal Section	0
Total	100%

Table 143

## BIOGEOGRAPHICAL DISTRIBUTION OF RUDDY DUCKS DURING THE 1958-59 SEASON

	Nov.3-12, 1958	Dec.1-12, 1958	Jan.7-13, 1959	Mar.3-16, 1959
Upper Western Shore Section	<u>68%</u>	<u>49%</u>	<u>45%</u>	<u>45%</u>
Patapsco River	(42)	(40)	(45)	( 0)
Back-Middle River area	( 0)	( 8)	( 0)	(30)
Bush-Gunpowder area	(10)	( +)	( 0)	(15)
Spesutie-Pooles Island area	(16)	( 1)	( 0)	( 0)
Central Potomac Section	<u>21%</u>	<u>10%</u>	<u>23%</u>	<u>21%</u>
Lower Western Shore Section	<u>4%</u>	<u>0%</u>	<u>25%</u>	<u>0%</u>
Calvert County Shore	( 0)	( 0)	(25%)	( 0)
Choptank River Section	<u>4%</u>	<u>13%</u>	<u>0</u>	<u>4%</u>
Central Choptank	( 3)	(12)	( 0)	( 2)
Central Western Shore Section	<u>4%</u>	<u>2%</u>	<u>4%</u>	<u>14%</u>
Lower Potomac Section	<u>1%</u>	<u>3%</u>	<u>7%</u>	<u>8%</u>
Upper Potomac Section	<u>1%</u>	<u>10%</u>	<u>0</u>	<u>4%</u>
Patuxent River Section	<u>4%</u>	<u>1%</u>	<u>4%</u>	<u>3%</u>
Lower Eastern Shore Section	<u>0</u>	<u>6%</u>	<u>0</u>	<u>4%</u>
Eastern Bay Section	<u>1%</u>	<u>3%</u>	<u>0</u>	<u>4%</u>
Blackwater-Nanticoke Section	<u>1%</u>	<u>4%</u>	<u>0</u>	<u>1%</u>
Chester River Section	<u>4%</u>	<u>2%</u>	<u>0</u>	<u>4%</u>
Upper Eastern Shore Section	<u>0</u>	<u>1%</u>	<u>0</u>	<u>0</u>
Susquehanna Flats Section	<u>4%</u>	<u>0</u>	<u>0</u>	<u>0</u>
Coastal Section	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
Total Populations	61,600	53,000	18,200	30,300

Table 144

FOODS OF 11 RUDDY DUCKS FROM FRESH ESTUARINE BAYS  
OF THE GUNPOWDER AND POTOMAC RIVERS<sup>1</sup>

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Leaves, Stems and Rootstalks of Submerged Aquatic Plants	<u>55%</u> (23-84)
Wildcelery	55 (23-84)
Sago Pondweed	9 ( +-42)
Pondweed	9 ( +-42)
Seeds	<u>18%</u> ( 2-52)
Widgeongrass	9 ( +-42)
Grassleaf Pondweed	9 ( +-42)
Corncockle	9 ( +-42)
Grain	<u>27%</u> ( 6-61)
Wheat (bait)	27 ( 6-61)
Animal Food	<u>18%</u> ( 2-52)
<u>Planorbis</u> sp. (Gastropoda)	9 ( +-42)
Chironomidae larvae	9 ( +-42)

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<sup>1</sup> Collected October-March. Percentage occurrence of foods that made up 5% or more of the volume in individual birds. Figures in parentheses show 95% confidence limits.

Table 145

FOODS OF 9 RUDDY DUCKS FROM BRACKISH ESTUARINE BAYS OF THE  
CHESTER, PATUXENT, AND POTOMAC RIVERS<sup>1</sup>

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<b>Seeds</b>	<u>33%</u> ( 7-71)
Southern Naiad	22 ( 2-61)
Claspingleaf Pondweed	22 ( 2-61)
Widgeongrass	11 ( +-49)
Grassleaf Pondweed	11 ( +-49)
<b>Animal Food</b>	<u>67%</u> (29-93)
<u>Macoma phenax</u> (Pelecypoda)	56 (21-87)
<u>Mya arenaria</u> (Pelecypoda)	33 ( 7-71)
Gammaridae	22 ( 2-61)
<u>Macoma balthica</u> (Pelecypoda)	11 ( +-49)
<u>Mulinia lateralis</u> (Pelecypoda)	11 ( +-49)
<u>Cyathura</u> sp. (Isopoda)	11 ( +-49)
Xanthidae	11 ( +-49)
Crustacea (sp.†)	11 ( +-49)

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<sup>1</sup> Collected November-March. Percentage occurrence of foods that made up 5% or more of the volume in individual birds. Figures in parentheses show 95% confidence limits.

Table 146

FOODS OF 9 RUDDY DUCKS FROM TURBID BRACKISH ESTUARINE BAYS  
OF FISHING BAY AND THE NANTICOKE RIVER<sup>1</sup>

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<b>Seeds</b>	<u>11%</u> ( +-49)
Olney three-square	11 ( +-49)
<b>Animal Food</b>	<u>100%</u> (66-100)
<u>Macoma balthica</u> (Pelecypoda)	56 (21-87)
<u>Mulinia lateralis</u> (Pelecypoda)	44 (13-79)
<u>Acteocina canaliculata</u> (Gastropoda)	44 (13-79)
<u>Chiridotea coeca</u> (Isopoda)	22 ( 2-61)
<u>Gemma gemma</u> (Pelecypoda)	11 ( +-49)
<u>Sayella chesapeakea</u> (Gastropoda)	11 ( +-49)
Gammaridae	11 ( +-49)

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<sup>1</sup> Collected January-April. Percentage occurrence of foods that made up 5% or more of the volume in individual birds. Figures in parentheses show 95% confidence limits.

Table 147

FOODS OF 10 HOODED MERGANSERS FROM VARIOUS HABITATS<sup>1</sup>

	Brackish Estuarine Bay Marsh 2 Birds	Fresh Estuarine Bay 3 Birds	River Bottomlands 3 Birds	Interior Impoundments 2 Birds
Fish	100%(15-100)	100%(29-100)	100%(29-100)	100%(15-100)
Centrarchidae (sp.?)			67 ( 9-100)	100 (15-100)
Johnny Darter ( <i>Etheostoma nigrum</i> )			67 ( 9-100)	
American Eel ( <i>Anguilla rostrata</i> )			33 ( +- 91)	
Ictaluridae (sp.?)			33 ( +- 91)	
Cyprinidae (sp.?)			33 ( +- 91)	
<i>Fundulus</i> sp. (Poeciliidae)	50 ( 1- 99)			
Undetermined sp.	50 ( 1- 99)	100 (29-100)		
Crustaceans	100 (15-100)		33 ( +- 91)	
Xanthidae	100 (15-100)			
<i>Cambarus</i> sp. (Decapoda)			33 ( +- 91)	
Insect Larvae and Nymphs		33 ( +- 91)		100 (15-100)
Libelluloidea				100 (15-100)
Trichoptera		33 ( +- 91)		50 ( 1- 99)

<sup>1</sup> Collected November-March. Percentage occurrence of foods that made up 5% or more of the volume in individual birds. Figures in parentheses show 95% confidence limits.

Table 148

ECOLOGICAL DISTRIBUTION OF AMERICAN COOT POPULATIONS IN THE  
UPPER CHESAPEAKE REGION DURING THE 1958-59 SEASON

	Nov.3-12, 1958	Dec.1-12, 1958	Jan.7-13, 1959	Mar.3-16, 1959
Fresh Estuarine Bays	44%	12%	2%	1%
Slightly Brackish Estuarine Bays	10%	45%	17%	58%
Brackish Estuarine Bays	40%	38%	78%	41%
Salt Estuarine Bays	+	+	3%	0%
Coastal Impoundment - Bay Complex	6%	5%	0%	0%
Total Populations	17,000	18,400	3,600	5,300

Table 149

BIOGEOGRAPHICAL DISTRIBUTION OF AMERICAN COOTS  
DURING THE WINTERS OF 1955-59

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Chester River Section	22%
Central Potomac Section	16%
Eastern Bay Section	15%
Choptank River Section	13%
Susquehanna Flats Section	10%
Central Western Shore Section	8%
Patuxent River Section	5%
Lower Potomac Section	4%
Upper Potomac Section	2%
Blackwater-Nanticoke Section	2%
Lower Eastern Shore Section	2%
Upper Western Shore Section	1%
Upper Eastern Shore Section	+
Coastal Section	+
Lower Western Shore Section	0%
Total	100%

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Table 150

BIOGEOGRAPHICAL DISTRIBUTION OF AMERICAN COOTS  
DURING THE 1958-59 SEASON

	Nov.3-12, 1958	Dec.1-12, 1958	Jan.7-13, 1959	Mar.3-16, 1959
Central Potomac Section	<u>10%</u>	<u>45%</u>	<u>17%</u>	<u>57%</u>
Chester River Section	<u>34</u>	<u>27</u>	<u>19</u>	<u>17</u>
Central Chester River	(34)	(26)	(19)	(17)
Central Western Shore Section	<u>5</u>	<u>5</u>	<u>14</u>	<u>18</u>
Upper Western Shore Section	<u>20</u>	<u>9</u>	<u>0</u>	<u>2</u>
Susquehanna Flats Section	<u>24</u>	<u>0</u>	<u>1</u>	<u>+</u>
Choptank River Section	<u>0</u>	<u>6</u>	<u>10</u>	<u>3</u>
Coastal Section	<u>6</u>	<u>5</u>	<u>0</u>	<u>0</u>
Eastern Bay Section	<u>0</u>	<u>0</u>	<u>4</u>	<u>2</u>
Patuxent River Section	<u>1</u>	<u>1</u>	<u>0</u>	<u>1</u>
Upper Potomac Section	<u>0</u>	<u>2</u>	<u>1</u>	<u>0</u>
Lower Western Shore Section	<u>+</u>	<u>+</u>	<u>3</u>	<u>0</u>
Upper Eastern Shore Section	<u>+</u>	<u>1</u>	<u>0</u>	<u>0</u>
Lower Potomac Section	<u>0</u>	<u>+</u>	<u>0</u>	<u>1</u>
Blackwater-Nanticoke Section	<u>0</u>	<u>0</u>	<u>+</u>	<u>0</u>
Lower Eastern Shore Section	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
Total Populations	17,000	18,400	3,600	5,300

Table 151

HARVEST AREAS (INDIRECT RECOVERIES) OF AMERICAN COOTS  
BANDED IN THE UPPER CHESAPEAKE REGION<sup>1</sup>

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Mid-Atlantic States	<u>42%</u>
North Carolina	26
Maryland	16
Eastern Great Lakes Area	<u>11%</u>
Ontario	5
Michigan	5
North-Central States	<u>47%</u>
Wisconsin	42
Minnesota	5
Total	100%

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<sup>1</sup> 19 banded in Chester River, Eastern Bay, Blackwater River, and Hooper Island Areas, during February 17 - April 3, 1955-57.



Fig. 1 — The Upper Chesapeake Region



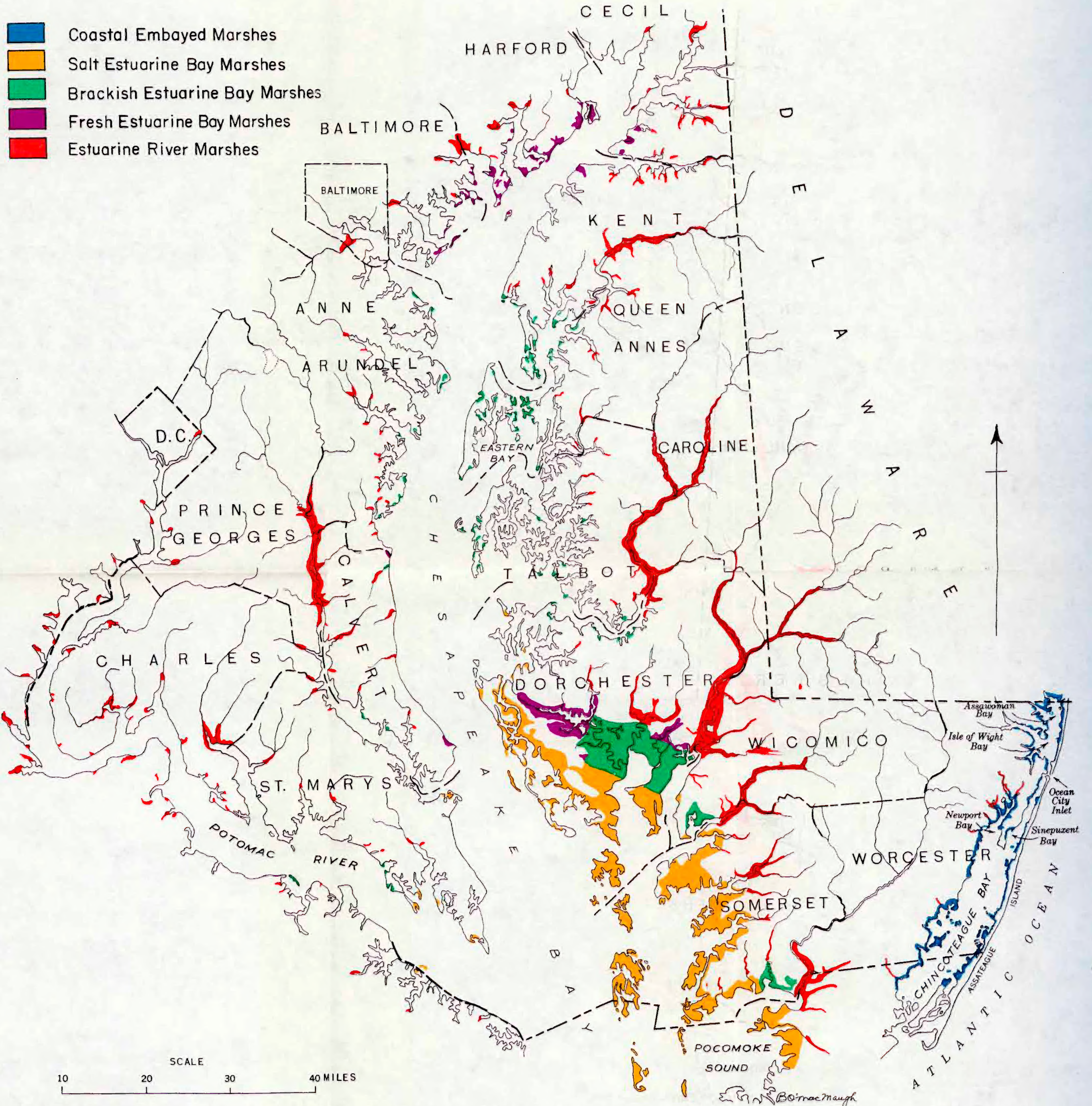


Fig 3 - Tidal Marsh Communities



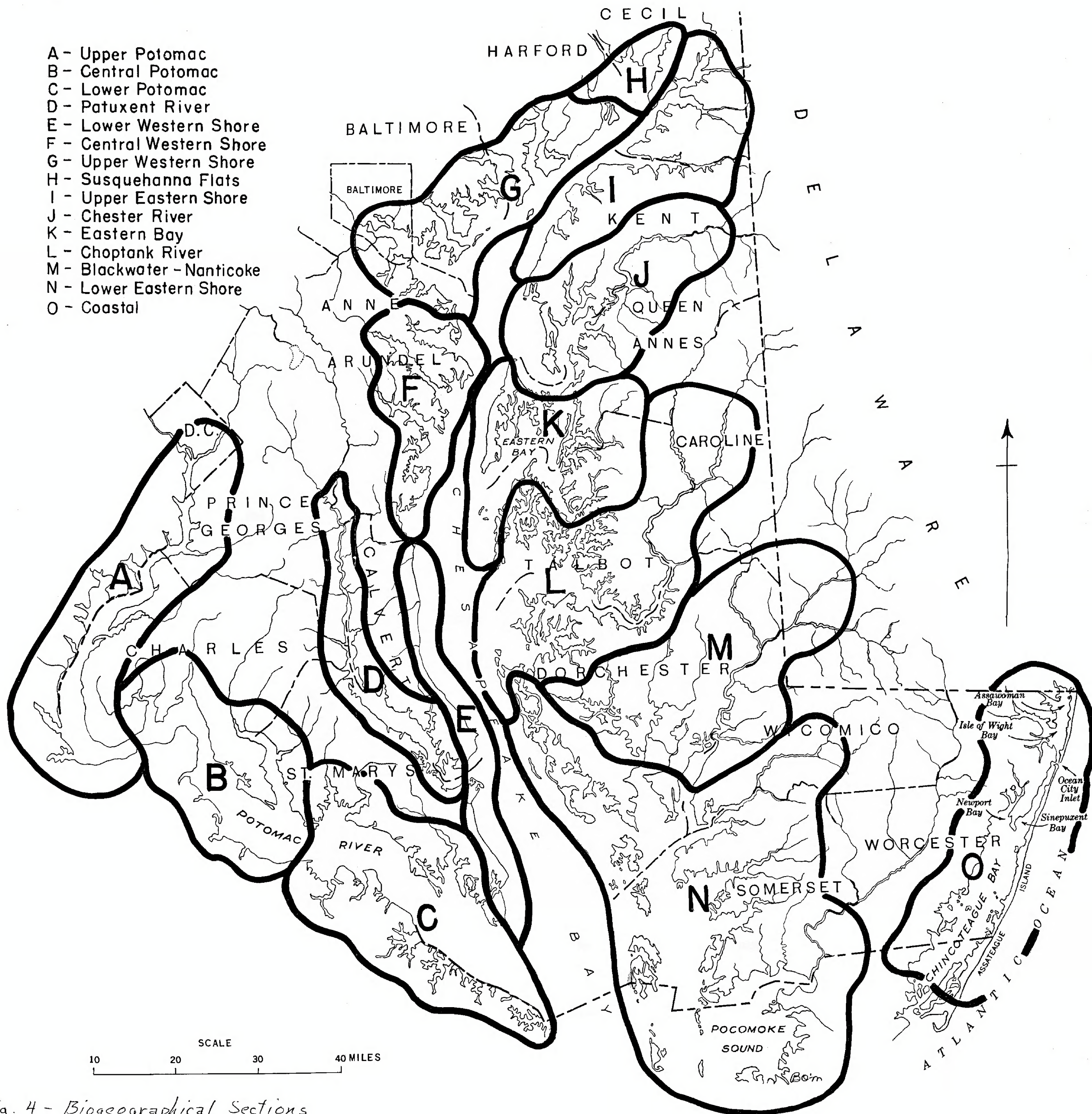


Fig. 4 - Biogeographical Sections





Fig. 2 - Estuarine Bay Communities